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THE FUTURE.

British Guiana has benefited immensely by the present war. We are in the enviable position of being very remote from unpleasant circumstances such as air raids, wholesale compulsory rationing of our food and other horrors of modern warfare of which we read often and appreciate but little. We could, however, have benefited to an infinitely greater extent had we, in the earlier years of the war, more fully grasped what lay in store for us. Let us discuss the agricultural viewpoint.

This colony abounds in great tracts of lands of wonderful fertility, only a minute portion of which have been cultivated. In these days complaints are heard on every side in reference to the scarcity and high prices of local agricultural produce. If, in 1914, the farmers throughout the colony could have anticipated the present situation it is safe to predict that our supplies of food grown within the colony would be now neither short or high in price. The farmer makes good profits to-day ; they would be much larger had he but looked in the future. The successful farmer has often been adequately defined as being a man of sound commonsense who looks well ahead.

Let us suppose, and it is no unlikely supposition, that the war is going to last for another four years. Towards the end of that period how shall we, in British Guiana, stand with regard to our food supplies? It is more than probable that as time goes on we shall be more and more forced to rely on the food produced within the colony.

Will those supplies be forthcoming? They will be if only our farmers at this time, when the opportunity is still within reach, increase to their fullest individual extent the acreage under all forms of provision crops.

No great originality attends these statements. Future events here, even during the earliest days of the war, were predicted by those in authority and a general warning was then given to the agriculturists. We take the opportunity however, when this Journal is entering into a sphere of increased popularity and utility among the farmers of British Guiana, once more to bring into prominence a subject that should undoubtedly be a matter of very earnest consideration for all classes of the agricultural community.

THE BOTANICAL ASPECT OF THE SEA DEFENCE PROBLEM.

By C. K. Bancroft, M.A., Government Botanist.

One of the recommendations made by the Commission appointed in 1916 to report on the Sea Defences of the Colony was the encouragement of the growth of vegetation on the coast. For this purpose a sum of $960 was voted by the Combined Court on April 2nd, 1917, in order that investigations might be conducted in planting the foreshore.

The effect of vegetation in accumulating sand or mud on the foreshore in different parts of the world has been recognised for many years and has received the attention of eminent botanists. An article which appeared in the "Field," November 17th, 1917, dealing with the growth of *Spartina Townsendi,* a grass allied to our common rice grass, *Spartina brasiliensis*, and produced in this number of the Journal, shows to what extent vegetation may be employed for raising the level of the foreshore.

In the tropics observations have been made on coastal vegetation principally from the purely botanical or more properly ecological standpoint. In no case does it appear that any accurate data have been collected which are likely to prove of practical value in the investigations which are at present in progress. The existence of definite associations of plants on the coastlands in the tropics was many years ago recognised and described by botanists ; certain plants have been recognised to be relegated to definite habitats ; zonal distribution of the vegetation has been recognised ; but the literature on the subject is very scant more particularly as far as concerns the western tropics and affords little, if any thing, to work on. The only work of any practical value which has hitherto been carried out in this colony in regard to planting on the foreshore was conducted by Mr. J. Junor when Manager of Plantation Vryheid's Lust on the East

Coast of Demerara. An account of this work has already been given in Vol. I. No. 3 of this Journal. The plants employed were the rice grass mentioned above and the wild mangrove (*Rhizophora Mangle.*) The planting was confined to muddy parts of the shore. As far as is known no planting has hitherto been done on sandy parts of the foreshore in this colony. Sand is considered by certain experts to be the most valuable material for forming a natural protection for the coast.

To arrive at accurate data which are likely to lead to a solution of the problem careful and continuous investigation is needed. A leap in the dark may lead to the expenditure of large sums of money to no useful purpose. The investigations, to be of any value, must be conducted continuously for a period of years. Tidal influences, the effect of fresh water and of salinity, the effect of wave action, the rates and mode of growth of species under different conditions of the substrate, the changes which are being undergone in the vegetation existing on different parts of the coast, these and many other factors require careful study. An important consideration is the possibility of introducing foreign species which may fulfil certain requirements lacking in the shore plants indigenous in the colony. This appears to be feasible more particularly in regard to the sandy parts of the coast. Finally, experimental plots must be early established at selected places on the coast to test the value of different species for coastal protection.

The investigations are being conducted principally with a view to the following :—

(1) The possibility of increasing the rate of accretion between groynes by planting up (a) mud and (b) sand.

(2) The possibility of increasing the rate of accumulation of silt between abandoned dams and new dams during the time, the old dams act as a shelter to the new dams and protect them from wave action.

(3) The effect of plants in collecting sand at the land end of groynes and binding it.

(4) The best plants to use for the purpose of consolidating new dams on the top and on the land side.

(5) The best plants to employ for encouraging rapid accretion and also at points where rapid accretion is taking place.

(6) The best plants to grow when the shore has been built up to the required level.

(7) The use of artficial screens to build up a sand ridge in conjunction with vegetation.

(8) The possibility of substituting a low growth for an existing tall growth on the shore.

The coast-line of the colony of British Guiana extends from the eastern mouth of the river Orinoco to the river Courantyne for a distance of 270 miles. The littoral portion of the colony is formed by a plain of marine alluvium that rises southwards from the sea with a gentle slope. The fringe of vegetation on the coastline resembles in most of its features that of the low shores of Northern South America.

A botanical survey of the coast has shown the existence of some 40 species belonging to different families. Many of these do not occur under actual saline conditions and may be considered useless for coastal protection.

The existing plant associations on the coast are for the most part well-defined. They may be classified thus :—

(1) *Psammophilous halophytic formation* comprising sand-loving species of low growth which are essentially photophilous, i.e. incapable of enduring shade. This formation forms a third zone of vegetation on the foreshore, the two former being sand algae and bacteria. This zone is flooded with seawater at intervals, being subjected to inundation at springs but not at neap tides. The formation is an open one the plants being usually separated owing to the unsettled nature of the soil which is

disturbed by high tides and winds. The species are for the most part perennial herbs. The two dominant species are *Ipomoea—Pes Caprae* and *Canavallia ensiformis.* Along with them occur, more especially in drier parts, *Alternanthera, Sesuvium, Fimbristylis,* and *Heliotropium* and in wetter spots *Sporobolus* and *Batis.* This formation occurs on the foreshore at Kitty, on parts of the Essequibo Coast as at Suddie and on other parts of the coastline.

(2). *Halophilous Forest* or Bushland on sand. The vegetation on the sandy foreshore is succeeded on the landward side by a taller growth. The associations are dominated by *Thespesia* and *Hibiscus tiliaceus* (Mahoe). Along with these occur *Bontia, Ruellia, Achryanthes, Cassia bicapsularis* and *Malachra capitata.* The trees are short with leathery leaves. The formation is comparable with the Barringtonia Association in Eastern Asia and Australia.

(3).. *Pelophilous Halophytes.* To this formation belong essentially Courida and Kiara (*Laguncularia racemosa*) as also do Sporobolus and Spartina. The shore at Sancretal Bay (Waini Mouth) furnishes an excellent example of this formation. The coastline from the Pomeroon River to the Waini Mouth and muddy flats on the East and West Coasts of Demerara consist mainly of this formation. It is also present on coasts bounding the Carribean Sea where flat expanses of clay occur. Courida grows at its best here.

(4). *Littoral Swamp Forest.* This formation is dominated by the Mangrove or Courida along with Laguncularia and some other species. The distribution of the species is zonal ; although the reason for this is not clear. Probably adaptability and fixation in the soil play an important part, although salinity may also be a determining factor. It seems probable, since the Courida association is nearly always present on the exposed coast, while the Mangrove dominates the sheltered parts of the Coast and the banks of the rivers near the mouth, that fixation is an all-important factor, more particularly in the early stages of growth.

(5). *Reed Swamp Formation.* This is not typically fresh water swamp but is immediate between fresh and salt water, and is dependent on rains. Fimbristylis, Typha and other such species are common along with Sporobolus. It is meadow swamp occurring just aback of the coastline. Here Courida grows but not plentifully.

From the outset two points are clear ; firstly, vegetation can only be used to assist in the accumulation of silt or sand for the building up of the foreshore. Where erosion is going on vegetation is useless for protection ; secondly, except in special cases the area in which vegetation is of value is the area between high springs and high neap tides.

The economic side of the question demands that a species can only be employed which can be easliy propagated and which is capable of growing rapidly and becoming early established. Early experiments have led us to conclude that of the mud-loving species of trees the courida (*Avicennia nitida*) can be propagated most easily of all. Its seeds germinate at the rate of 100 per cent. ; its vivipary ; its method of anchoring itself in the substrate; its extremely rapid growth on a mud flat which is undergoing slow accretion are all points in its favour. The rice grass is also easily propagated ; it spreads rapidly and consolidates early. It possesses the very important faculty as does the "Marram" grass growing on sand in England, of rapidly growing through the mud when it has become covered. The mangrove is of slower growth than the courida and is not so easily propagated ; but its enormous buttress roots appear to render it a more valuable plant for coastal protection than the courida. The kiara (*Laguncularia racemosa*) possesses light seeds which are easily washed away by the tide and is hence difficult to establish. When once established it grows rapidly and for accumulation of silt it surpasses the courida. Being a plant of low growth it may prove of great value, since one of the aspects of the problem is the substitution of a low growth for a high growth on the foreshore from the point of view of the health of the inhabitants. Of the mud-loving species, the above with the crab-grass (*Sporobolus virginicus*) and the Eastern palm, *Nipa fruticans*, which occupies in the Malayan Archipelago a place

similar to the Mangrove in this colony, are the most promising from our early trials.

Of sand-loving species there are several which characterise the vegetation of the sandy parts of the foreshore. Those worthy of special mention are *Sesuvium portulacastrum*, *Alternanthera aggregatus*, both low-growing plants, and the two creepers *Ipomoea Pes-Caprae* and *Canavallia ensiformis*. Of these the one which appears to be most effective as a sand-binder is the first-named. In the association in which it occurs it occupies an advanced position, growing nearer to the level of high neap tides than any of the other species. *Ipomoea Pes-Caprae* is of rapid growth but is not so effective a sand-binder as *Sesuvium*. Of the other species *Canavallia* appears from our early trials to be difficult to establish ; while the *Alternanthera* does not appear to have any special qualities to recommend it for sand-binding. None of the above species appear to be able to grow through the sand readily as is so with "Marram grass" in temperate countries. They are, therefore, liable to become smothered when a rapid accumulation of sand is taking place. *Sesuvium* takes part in the formation of "hummocks" or small dunes, as can be seen on the shore at Bel-Air, East Coast, Demerara, and near to the Oene Creek, Essequibo Coast, but does not appear to be so capable of producing as rapid an accumulation of sand as the "Marram grass." In this colony storms do not occur on the coast, hence the sand shifts very slowly, and the plants are not so liable to become rapidly buried as in temperate regions. *Thespesia populnea* and the Mahoe (*Hibiscus tiliaceus*) frequently occur either together or in separate associations aback of the vegetation on the immediate foreshore. They are not tall trees and show promise of being useful for planting up under the same conditions as they occur in nature. Our early trials have shown us that the Mahoe is difficult to propagate either by cutting or from seeds. For this reason it will not only be difficult but expensive to plant extensively on the shore. It grows rapidly, however, is decumbent in habit and stands covering with sand, rooting readily from buried stems and thus propagting itself vegetatively. This

habit along with its decumbent mode of growth render it of great promise for sea-defence purposes. There is a well-established growth of Mahoe at Queenstown, Essequibo. There the interlacing stems of the old plants are comparable with the buttress roots of the mangrove.

The importance of demonstration plots was early recognised. During the first year it was intended that the plots should be few and small, in order to avoid unnecessary expenditure which would arise if large areas were planted, owing to failures which were sure to occur. Six plots were planted during the past year. Spots were carefully selected as representing different conditions existing on the coast and were planted together with eighteen different species with the object of studying their growth under different conditions. These plots should supply early and accurate data towards the solution of the problem.

One of the most difficult questions with which we are faced is the rapid growth of vegetation on areas situated between the old sea dams, which will shortly be abandoned, and the new dams situated behind them. At the present time the existing conditions in these areas are entirely different to what they will become when the old sea dams are abandoned. When the old dams are abandoned the space between them and the new dams will rapidly become converted into a muddy foreshore. Any attempt therefore, to rear in such places at the present time plants which will grow under the existing conditions will be fruitless, since as soon as the existing sea dams are abandoned the entrance of salt water along with a quantity of silt will so alter the existing conditions as to result in the death of these plants.

To be continued.

THE SUGAR CROP OF 1916-17.

By Professor J. B. Harrison, C. K. Bancroft, & R. Ward.

The gradual substitution of the Bourbon cane by new varieties raised by seed continued in 1915. The total area under cane for the crop in 1916-17 was 78,346 British acres, an increase of 2,602 on the area planted for the crop of 1915-16 D 625 was planted over 37,174 acres or nearly one-half of the total acreage of the whole colony. The Bourbon was planted over 9,109 acres—a decrease of 1,686 acres below the area planted for the crop of 1915-16. The relative proportion of the principal varieties cultivated for the crop of 1916-17 is shown in the following table :—

	For crop of 1915-16	For crop of 1916-17
D 625	50.50	49.08
Bourbon	14.74	12.03
D 145	8.09	8.04
B 208	9.33	7·92
Mixed Bourbon & seedlings principally D 625	3.71	6.98
D 109	2·39	2.28
Diamond 185	2·45	2.09
Green Transparent	1.58	1.79
D 118	.77	1.17
D 419	.29	.53
Other Varieties un-numerated	6.15	8.09
	100.00	100.00

The average yields in tons of commercial sugar per acre of the principal varieties under cultivation as deduced from returns supplied by the Managers of the Sugar plantations were as follows : —

Variety.	Tons sugar per acre	Variety.	Tons sugar per acre.
D 216	3.00	D 305	1.82
D 433	3.00	D 199	1.81
Java 247	2·81	D 44	1.80
D 419	2.67	Java 2	1.78
R.P. 6	2.53	D 115	1·77
Sport 625	2.41	D 74	1.75
D 167	2.36	White Transparent	1.75
R.P. 9	2.32	B 1566	1.75
D 405	2.28	D 651	1.75
D 294	2.23	B 376	1·74
Diamond 33	2.22	D 4395	1.74
D 642	2·20	D 754	1.74
Diamond 581	2.20	B 147	1.74
D 109	2.20	D 145	1.72
D 118	2.16	Green Transparent	1.72
Red Ribbon (Egyptian)	2.15	R.P.89	1·70
D 721	2.15	D 1087	1.68
D 108	2.13	D 165	1·66
D 101	2.12	P L 10	1.62
D 121	2·11	B 208	1.62
D 482	2.10	D 95	1.60
Java 4	2.10	Diamond 382	1.58
Bourbon	2.10	B 317	1.57
B 3412	2.07	Java 3	1.57
D 325	2.06	P L 9	1.53
D 98	2.00	D 4399	1.52
P.L. 28	2.00	D 159	1.50
P. L. 254	2.00	P P 1	1.50
B 216	1.96	D 179	1·48

D 635	1.94	D 1753	1.45
D 65	1.92	D 4397	1.41
B 6450	1.90	D 216	1.35
P.L. 27	1.88	D 117	1·35
Diamond 399	1.88	Sealy	1.23
D 520	1.87	D 179	1.20
Diamond 185	1.85	Java 1	·87

The export of sugar for the year 1916 was 101,649 tons, a decrease of 14,574 tons on that of 1915. The total export of rum was 4,386,854 proof gallons or 311,376 gallons in deficit of that of the previous year. No molasses was exported during the year as by far the greater proportion of it was used in the preparation of rum. The export of molascuit was 997 tons, or 1,236 tons less than in 1915.

The following table shows the actual production of sugar as reported by the Planters Association and the amounts exported during the years 1911 to 1916 :—

		Sugar tons.	
		Produced.	Exported.
1911	..	108,175	98,453
1912	..	86.410	77.321
1913	..	106,211	87·414
1914	..	116,622	107·138
1915	..	119,091	116,224
1916	..	114,292	101,650
	Means	108·467	98,116

THE HOUSE-FLY.

HOW IT LIVES, HOW IT SPREADS DISEASE, AND HOW TO DESTROY IT.

By L. D. Cleare, Jnr., F.E.S.
Bioloigcal Division. Department Science and Agriculture.

There is probably no insect better known to the world at large than the common house-fly, *Musca domestica* L. ; found practically wherever mankind exists the house-fly may be said to be truly cosmopolitan. British Guiana is no exception to this rule and, while in Georgetown itself the house-fly cannot be said to be a bad pest, there are parts of the colony where these insects abound.

Up to about twenty years ago the house-fly was usually regarded as a mere nuisance and its existence was excused on the grounds of its habits as a scavenger, for in this way it was considered to be of value to mankind. In British Guiana this idea still exists among a large proportion of the inhabitants who are not yet versed in the abominable habits of these creatures.

Within recent years, however the whole aspect of the subject has been changed and now instead of regarding the house-fly merely as a nuisance we have to consider it amongst our most dangerous insects, a filthy creature, the very existence of which ought not to be allowed.

WHERE FLIES BREED.

The house-fly in all its phases is a filthy creature. Its eggs are laid in filth on which the ' maggots ' feed, and finally when the adult flies emerge they visit similar substances to deposit their eggs and obtain food, in this way spreading disease.

Broadly speaking, house-flies will breed in almost any kind of decaying vegetable or animal matter and in excrementous substances, provided that the conditions of temperature and moisture are suitable. Horse manure is preferred as a food for the larvae and hence heaps of stable manure are the principal breeding places for these insects. In addition the larvae have been obtained from accumulations of garbage from kitchens ; the manure of fowls, pigs, and cattle; decaying vegetables and fruits such as potatoes, bananas, mangoes ; and human excrement, both as isolated faeces and in latrines, as well as mixed with ashes. Open privies are most dangerous , for flies not only breed therein but later visit them to obtain food and from these places the germs of typhoid fever, dysentery, and other enteric diseases are carried to the food of man.

LIFE HISTORY.

The house-fly, in common with all other flies, has four distinct stages in its life history. First the egg, then the larva or 'maggot,' next the pupa or resting stage, and finally the adult fly.

There is still a popular idea that house-flies grow and that the small flies seen about decaying fruit, etc, are 'young house-flies.' This idea is entirely erroneous for the perfect insect after it has emerged from the pupa is incapable of growth—little flies never become big flies. The smaller fly is a distinct species.

The enormous numbers with which the house-fly is capable of reproducing is one of the most remarkable features of this insect and can be attributed to two chief causes : (1) the universal prevalence of substances that are highly nutritious to the larvae and in which they freely breed, and (2) the rapidity of development. The rate of development is largely governed by temperature, moisture and the character of the food. In a climate such as this moisture plays a very important part indeed and recent investigations carried out by the writer show a close relationship between moisture and the prevalence of house-flies. When it is understood

that a single female fly is capable of depositing five or six batches of eggs each containing between 100 and 150 eggs, and that these eggs will produce adult flies in a little over a week it is an easy matter to account for the swarms of flies that sometimes occur.

The eggs (fig 1) of the fly are small, about one-twenty-fifth of an inch in length, pearly white in colour, cylindrically oval in shape and slightly curved in its long axis with one end broader than the other: they are thus 'not unlike a banana slightly thickened and blunted at one end.' The fly deposits the eggs usually in clusters in narrow crevices near the surface of such substances as will provide food for the larvae. The female fly is enabled to place the eggs in such positions, where they cannot undergo dessication, by means of her lengthy ovipositor which is exerted for the purpose. The eggs hatch in from eight to twenty-four hours after they are laid; the young maggot emerging through a slit which is formed along the egg.

The larva.—The freshly emerged larva is a tiny creature of a glistening white colour. It is extremely active, immediately burrows into its food substance and disappears from sight. Before the larva becomes full grown it casts its skin twice, and therefore has three larval stages.

The full grown larva (fig. 2) is a creamy white legless maggot measuring ½ inch in length. The body gradually tapers off from the middle to the anterior end while the posterior half is thicker and terminates bluntly. Twelve distinct segments may be seen in the larva but in reality there are thirteen, the second segment being of a double nature. The head of the larva is withdrawn into the anterior end, so that it appears headless, and from this end a black, hook-shaped, tooth-like projection may be seen under which the mouth is situated. On the underside of the larva, on each of the segments from the sixth to the twelfth is a pad covered with tiny spines. These pads take the place of legs, and are used by the larva in conjunction with the mouth hook for travelling backwards or forwards.

The pupa. (fig 3). When fully grown the larva usually leaves the moist situation where it has developed and crawls

away to a drier place to pupate, often covering several yards in search of such a place, where the pupae are sometimes found in hundreds. After a short rest the larva commences to change to the pupal stage. The skin contracts the anterior segments are withdrawn and it assumes a cylindrical shape, the anterior posterior ends being evenly rounded. In a few hours the pupa changes its colour from a creamy yellow to a rich dark brown. The larval skin forms the pupal case or puparium in which the transformations from the larva to the adult takes place. The pupa measures about ¼ inch in length.

In from three to five days after pupation the adult fly emerges by pushing off the anterior end of the pupal case. When the fly first emerges the wings are crumpled but after an hour or two they straighten out and the insect takes flight.

The adult fly.—The adult house-fly is familiar to everyone and a description is unnecessary. See drawing on the folder in this article.

In a few days after emergence from the pupae the female fly becomes sexually mature, and three or four days after that she is able to deposit eggs.

The total length of the life cycle in this country is about twelve days.

HABITS OF THE ADULT FLY.

The filthy habits of the house-fly in the early stages are as nothing when compared with those of the adult. The larvae only develops in such places as are chosen by the female fly to lay her eggs and here, in the earliest stages, it is the adult that shows the preference for obnoxious substances. After the larvae have grown, pupated. and the adult flies have emerged these habits are continued and we find the house-fly visiting all kinds of filth in order to obtain food. Open privies, pig-pens, carrion, garbage and manure heaps are all visited freely. From these places, with their feet and bodies covered with disease germs, they visit our markets, kitchens,

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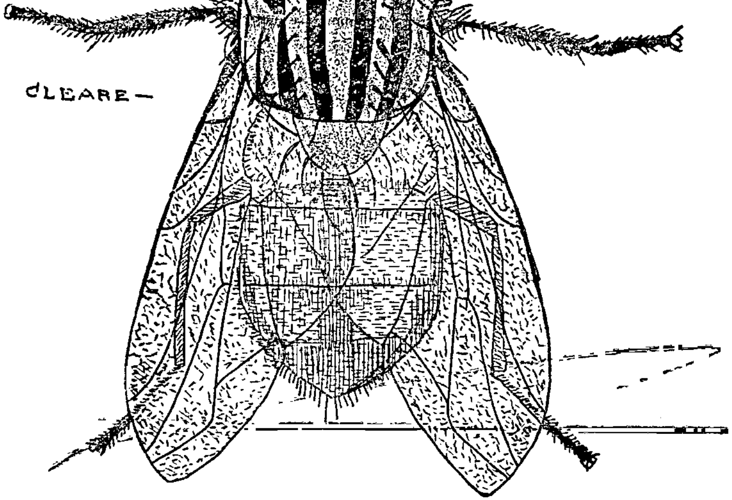

FLIES CARRY DISEASE

LIVE AND BREED IN ALL KINDS OF FILTH

INFECT—YOUR—FOOD—BY—GERM-LADEN—FEET

ENTER CLOSETS AS WELL AS YOUR KITCHEN

SHOULD BE PREVENTED FROM BREEDING

and tables; wiping their feet on the meat, sipping the milk, and tasting the sugar and butter. One does not like to think that the fly now crawling about the butter dish was but a few minutes ago selecting for itself the choicest morsels from a garbage-can or feeding on even more indescriable filth, yet this is but the usual state of affairs. Flies and filth are practically synonymous terms.

Knowing its habits it is not difficult to understand how these creatures spread disease, and it has been estimated that the number of bacteria carried by a single house-fly may vary, according to the insanitary condition of its surroundings, from 550 to 500,000,000 per insect.

FLIES AND DISEASE.

Although it is only within recent years that flies have been proved to be carriers of disease, it must not be imagined that they were never suspected. From the very earliest times we have accounts of the association of these insects with various diseases for do we not read of the fourth plague of Moses "and there came a grievous swarm of flies into the land of Pharoah, and into his servants' houses, and into all the land of Egypt : the land was corrupted by reason of the swarm of flies" ?

From time to time within the past two centuries flies have also been suggested as spreading or causing diseases; and in 1871 we find Leidy suggesting that house-flies were responsible for the spread of hospital gangrene. In the same year Lord Avebury used the following significant sentence : "Far from looking upon them as dipterous angels dancing attendance on Hygeia, regard them rather in the light of winged sponges spreading hither and thither to carry out the foul behests of Contagion." None of these suggestions, however, were backed up by proof, with the result that they gained no ground.

About twenty years ago the house-fly came into prominence, chiefly through the work of Dr. L. O. Howard of the United States Bureau of Entomology, and since that time our knowledge

has been steadily increasing with regard to the biology of this insect. We now know the house-fly to be one of the most dangerous insects and largely the cause of such diseases as typhoid fever, dysentery, diarrhoea, and tuberculosis, and they have also been shown to be capable of conveying the eggs of parasitic worms.

TYPHOID FEVER.

It is now a well known fact that flies are largely responsible for the spread of typhoid fever. During the Spanish-American war in 1898, when one-fifth of the American soldiers contracted typhoid a commission of highly-qualified officers appointed by the United States Government to investigate the prevalence of this disease reported that "These pests had inflicted greater loss upon American soldiers than the arms of Spain had." Since that time house-flies have been associated with a number of outbreaks of typhoid and Howard went so far as to suggest that the name 'typhoid-fly' be substituted for that of house-fly.

The connection of flies with this disease and the manner in which it is spread will be better understood if certain of the features of typhoid fever are considered.

Typhoid fever is an intestinal disease and caused by the entrance of typhoid bacilli into the digestive system, usually by way of food and drink. Persons suffering from typhoid excrete typhoid bacilli. Research has shown that many patients continue to excrete these bacillil for long periods after the symptoms of the disease have disappeared and it is here that we find our greatest danger. Such persons are known as 'carriers.' Flies can readily obtain typhiod-bacilli from the faeces of these apparently healthy 'carriers' and from thence spread them about.

In properly sewered towns flies have very little access to these discharges, but in towns and villages where open privies are common, flies have great opportunities for infecting themselves and the food of man.

DYSENTERY AND DIARRHOEA.

Dysentery and diarrhoea are diseases often associated with the prevalence of flies.

Summer diarrhoea has recently been investigated in a number of towns both in England and the United States, and the evidence collected strongly suggests that house-flies play an important part in the dissemination of this disease.

Dysentery has been more extensively investigated in tropical countries. Bahr made a very careful study of dysentery in Fiji in 1912 and arrived at the following conclusion. "The phenomenal preponderance of flies in Fiji, the great frequency of dysentery there, the concurrence of the fly season with the dysentery season, the many opportunities supplied by the insanitary conditions obtaining in villages, plantations and public institutions for contamination of food by infected flies, are distinctly in favour of regarding Fijian epidemic dysentery as a fly-borne disease."

During 1916 an outbreak of enteric diseases occurred at a public institution in this colony and the writer had the opportunity to study the connection of flies with the outbreak. The conclusions arrived at were of a similar nature " and it was found that the diarrhoea and dysentery followed the rise and fall of the flies to a large extent."

TUBERCULOSIS.

Tuberculosis is but another of the diseases which flies are capable of disseminating under favourable conditions. The partiality which flies show for sputum is a matter of common observation. After infecting themselves both internally and externally they visit our food and drink and in this way spread the disease.

THE SPREAD OF PARASITIC WORMS.

It is also known that flies must often spread the eggs of the parasitic worms which infect human beings. The fact that the

eggs of these worms are passed out with the excreta, and that this substance, especially when fresh, is attractive to flies which feed greedily upon it will at once make the suggestion obvious. Extensive investigations have been carried out in this connection and the conclusions all point to the probability of flies disseminating such eggs. The possibility of the Hookworm being spread in this way should not be overlooked.

PREVENTION AND CONTROL OF FLIES.

It is evident that the best method of controlling fles is to prevent them from breeding ; thus ' prevention is better than cure ' should be the motto of everyone seeking to lessen the number of these insects. The substances in which flies breed have already been indicated and these substances should be dealt with immediately.

Horse manure, sweepings from stables, etc. should promptly be removed and placed in receptacles not accessible to flies. Many cities in the United States and Canada have passed bye-laws requiring that properly constructed pits or chambers shall be maintained for the temporary storage of manure in places where horses, cows, and similar animals are kept. These receptacles must be provided with covers so as to prevent the ingress or egress of flies and the manure must be removed at least once a week. Further regulations governing the construction of such stables insist that the floors of such places shall be of solid conrete and that good concrete drains be provided to connect up with the main drain.

Treatment of manure.—The treatment of piles of manure with substances to kill the maggots has been tried by a number of workers. Howard in 1897 found that chloride of lime was an effective maggot-killer, and that one pound of this substance mixed with 8 quarts of horse manure killed 90 per cent. of the maggots in twenty-four hours. Besides being expensive chloride of lime was

found to possess many objectionable features the most important being that if manure treated with this substance was kept near the stable the chlorine fumes arising from the pile so treated acted as an irritant to the eyes of live stock. This substance was therefore given up as impracticable.

Since that time a number of other substances have been experimented with. Extensive experiments have recently (1914) been carried out in the United States by Cook, Hutchinson and Scales who have come to the conclusion that manure may be successfully treated at a small cost with either borax or powdered hellebore.

Borax treatment.—In the borax treatment 0·62 pound of borax is applied to every 10 cubic feet (8 bushels) of manure immediately on its removal. The instructions given with regard to the use of this substance are " Apply the borax particularly around the outer edges of the pile with a flour sifter or any sieve, and sprinkle 2 or 3 gallons of water over the borax-treated manure. The reason for applying the borax to the fresh manure immediately after its removal from the stable is that the flies lay their eggs on fresh manure, and borax, when it comes in contact with the eggs, prevents their hatching. As maggots congregate at the outer edges of the pile, most of the borax should be applied there. The treatment should be repeated with every addition of fresh manure, but when manure is kept in closed boxes less frequent applications will be sufficient."

One of the greatest advantages in this system is that manure treated with borax in the above manner is apparently not injurious to plants. The authors, however, add "nevertheless borax-treated manure has not been studied in connection with the growth of all crops, nor has its culminative effect been determined. It is therefore recommended that not more than 15 tons per acre of the borax-treated manure should be applied to the field." . . . . " It is also recommended that all public-health officials and others in recommending the borax treatment for killing fly eggs and maggots in manure warn the public against the injurious effects of large amounts of borax on the growth of plants."

With borax costing 5 to 6 cents per pound (in U.S.A.) it has been estimated that it will cost 1 cent per horse per day to treat manure at the above rate, or 0.42 cent per bushel.

Hellebore treatment.—Powdered hellebore is also an effective larvicide and apparently exerts no injurious influence on the fertilizing value of the manure.

To quote again "Powdered hellebore, using one-half pound to 10 gallons of water and applying this to 8 bushels of manure, is also an effective larvicide and exerts no injurious action on the fertilizing value of the manure as determined by bacteriological and chemical analyses, and no injurious action on plants has been detected in any of the field tests."

The following instructions are given with regard to its application. " Powdered hellebore should be mixed with water at the rate of one-half pound to 10 gallons and the solution thoroughly stirred and allowed to stand for several hours in a barrel or other container. In order to obtain the most satisfactory results, the manure should be sprinkled with the foregoing solution immediately on removal from the barn. The sprinkling may be done with a watering can or similar device, using 10 gallons to 8 bushels of manure, taking care that all the hellebore comes in contact with the manure and paying particular attention to the outer edges of the pile. In estimating the amount of solution to be employed it may be assumed that 2 bushels of manure per horse is the daily output of the stable. This is a liberal estimate, and in many stables the daily output is much less."

Maggot traps.—Another method devised for dealing with manure is the use of a 'maggot-trap.' Hutchinson has designed a trap that appears to be highly successful and which ought to be more used.

The general plan of the trap is as follows :—A concrete basin, of a convenient size, is first constructed, the rim or wall of concrete being 4 inches high and 4 inches thick. An outlet pipe 4 inches in diameter is fitted in one corner toward which the floor

slopes a little so that water would run out easily, to this pipe a plug of soft wood is fitted for the purpose of retaining water when necessary. The outlet may be connected with a cistern, or with the main drain when the liquid is not required. Standing on the floor of the concrete basin a wooden frame in constructed about 2 feet smaller than the basin each way and supported on legs 1 foot high. A covenient number of strips of wood are run lengthwise and across the top of the framework strips of about 1 inch wide are nailed 1 inch apart. In the case of small traps a strong ½ inch wire mesh would probably answer quite as well. When a cistern is constructed it should be placed as close as possible to the trap.

Upon the platform the manure and stable refuse are placed. Each day, after the addition of fresh manure, the pile is sprinkled with enough water to moisten it thoroughly without causing any leaking. The concrete basin below the platform is covered with water to the depth of ½ inch in the shallowest part. Larvae migrating from the manure will fall into the water and be drowned.

Every three or four days the water is drawn off from the basin and the floor washed clean. Larvae that have fallen into the water and refuse are collected at the mouth of the outlet by means of a strainer. The basin is then again plugged and partly filled with water—either from the cistern or elsewhere.

In his investigations Hutchison calculated that at least 98 per cent. of the larvae breeding in the manure were thus destroyed.

There are a few difficulties connected with these traps such as the breeding of mosquitoes, the accumulation of rubbish in the concrete basin, and the evaporation of water therefrom. These first could be got over by treating the surface of the water with oil, whilst a little attention would suffice for dealing with the others.

Its advantages are the comparatively small inital cost and cheapness of maintenance ; the small amount of labour required for its operation ; and, its adaptibility for use at stables where the daily production of manure is large.

Close packing of manure. †—The close packing of manure is a very simple and apparently successful method of preventing fly-breeding. The pile should not exceed 5 feet in height, and should be well pressed down. In dry weather the surface should be sprinkled with water. Where such piles are to be formed the ground should either be cemented over or prepared by mixing one part by volume of mineral-wood-preserving oil with 40 parts of fine soil, spreading the mixture on the ground and beating it down ; one gallon of oil will suffice for 100 square feet.

Measures against the adults.—In the foregoing paragraphs the methods of control recommended have all been directed against the larvae. It is not always possible for an individual to employ these methods and sometimes one must fall back upon the adult if control is to be attempted. Here the method is to trap the adult flies and for this purpose various methods have been devised.

Fly-traps.—There are a number of wire traps on the market used for catching flies which work fairly successfully under certain conditions. The principle of design is the same throughout, their success depending upon the flies being attracted by a bait within the trap. The flies thus attracted to the trap pass along a cone into an upper compartment where they are imprisoned. Of this pattern the common 'balloon' trap is familiar enough.

It will be seen that the efficiency of these traps depends almost entirely on the attractiveness of the baits used therein and when there are a number of other attractive substances around their usefulness is considerably diminished.

Fly-baits.—A number of substances, usually poisonous which are attractive to flies are used as baits. Of these substances the most extensively used is formaldehyde. A tablespoonful of formaldehyde (40 per cent.) in a pint of equal parts of water and milk is one of the best solutions for this purpose.

Other attractive baits are molasses and vinegar, as well as mixtures of equal parts of these substances, together, and with formalin (4 per cent).

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†Review of Applied Entomology. Vol. IV. B. Part 9, p. 141. September, 1916.

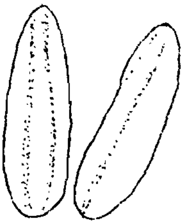

FIG. 1

Eggs of the house-fly, greatly enlarged.—After Hewi[illegible]

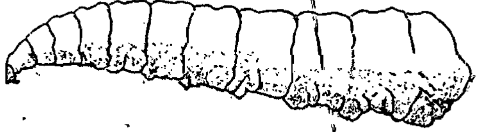

FIG. 2

Larva of the house-fly.—After Hewitt.

FIG. 3

Puparium of the house-fly—After Howard

CLEARE

The efficiency of these baits, as already pointed out, largely depends on the number of other attractive substances around and for this reason they often fail to be effective.

Fly-papers.—Where baits fail, fly-papers will usually prove effective; in additon to this their cost is small. The non-poisonous variety should always be used.

During the past two years, as other work would permit, the writer carried out a number of experiments with the object of finding a method by which fly-papers could be manufactured cheaply and as the result of these experiments the following formula has been devised.

Manilla wrapping paper 9 inches wide and weighing about 15 lbs. per roll of 150 yards is used. A mask of cardboard 12 inches long by 9 inches wide with a rectangular space of 10 by 8 inches cut out is made. The mask is placed on the paper which is marked out accordingly, the end of the one sheet being the commencement of the other. The paper is then cut up into strips of ten (or other convenient number) sheets.

These strips are now made oil proof by the application of a solution of 1 oz. of ordinary glue in 3 ozs. of water. The solution is applied with a *fine* brush to the marked side of the paper and must completely and *evenly cover the entire surface.* The strips are then allowed to dry.

After the paper has dried it is cut up into single sheets and the adhesive mixture consisting of 3½ozs. of resin and 1½ ozs. of engine oil is brought to the boiling point and immediately applied to the paper. This mixture must be kept within the 10 by 8 rectangle, thus allowng an uncovered margin of 1 inch. Two sheets are now applied face o face and stored thus until required for use. The *papers must be stored flat* and for preference in a cool dry place

The cost of papers made in this way is comparatively small and the following figures were obtained in my experiments.

Manilla paper	$ 1.68 per roll
Glue	.16 per lb.
Resin	.05 per lb.
Engine oil	·12 per pint.

A roll of paper will give 450 sheets which works out at 3 sheets for 1·1 cents or 20 sheets for 7.1 cents. 1 oz. of glue with 3 ozs. of water will cover 20 sheets at the cost of 1 cent· 3½ ozs. resin cost 1.1 cents and 1½ ozs. engine oil cost 1 cent, together they will cover 20 sheets at the cost of 2.1 cents. The total cost will therefore be about 10.2 cents for 20 single sheets, or 30.5 cents per lot of 30 double sheets.

The use of screens.—Screens should be used to protect confectionary and food offered for sale. Stalls, etc, not using one of the above contrivances should be boycotted. A visit to one of our markets and an inspection of the stalls, especially the butcher stall, would soon disgust most people.

In British Guiana house-flies do not receive the attention they deserve and are allowed to breed unchecked. The dangerous character of these creatures of abominable habits cannot be over-rated and it it hoped that in the near future an awakening in this respect will take place.

There is a belief among some people—particularly in this Colony—in accordance with the doctrine that there is some good in the existence of every creature, that the house-fly must perform some good service. In reply to this one cannot do better than quote Dr. C. Gordon Hewitt, the Dominion Entomologist of Canada, on the same question, who says " to such persons my reply is in the affirmative· House-flies certainly perform a valuable service ; they indicate the presence of filth and are the sanitarians danger signals, his red lamps in fact."

BIBLIOGRAPHY.

1912. Howard, L.O. 'The House-fly : Disease carrier: An account of its dangerous activities and of the means of destroying it.' xix + 312 p.p. 40 figs 1 col. pl. London. 1912.

——Hewitt, C.G. 'House-flies and how they spread diseases xiii + 122.19 figs. 1 frontpiece Cambridge 1912.

1914. Graham-Smith, G.S. 'Flies in relation to disease Non-bloodsucking flies' (2nd Edition). xvi + 389. 32 figs. XXVII pl. 20 charts. Cambridge 1914.

——Cook, F.C., Hutchinson, R.H., and Scales, F.M. 'Experiments in the destruction of fly larvae in horse manure.' U.S. Department of Agriculture Bulletin No. 118. (Contribution from the Bureau of Entomology. Professional paper.) 26 pp. 4 pls. July 14, 1914.

1915——Further experiments in the destruction of fly larvae in horse manure' U.S. Department of Agriculture Bulletin No. 245. (Contribution from the Bureau of Entomology. Professional paper.) 22 pp. 1 pl. 1 fig. July 20, 1915.

——Hutchison, R.H. 'A maggot trap in practical use; an experiment in house-fly control.' U.S. Department of Agriculture Bulletin No. 200. (Contribution from the Bureau of Entomology). 15 pp. 3 pls. 4 figs. May 4, 1915.

1916——Notes on the previposition period of the house-fly, Musca domstica L. 'U.S. Department of Agriculture Bulletin No. 345. (Contribution from the Bureau of Entomology. Professional paper.) 13 pp. 1 fig. 3 tables. February 5, 1916.

RICE CROPS AT THE EXPERIMENTAL FIELDS 1917.

By Professor J. B. Harrison, C.M.G., M.A., Director ; C. K. Bancroft. M.A. F.L.S.. Assistant Director and R. Ward, Agricultural Superintendent, Department of Science and Agriculture.

CROP OF 1917.

Varieties of proved value were planted in the North Field in the large scale trials in duplicate half-acre plots. In 1917 planting commenced on the 4th of May and the crop was reaped between the 8th and 12th of October. The crop took just over five months to mature. The yields obtained with the different varieties were :—

	Bags of 140 lbs. *per acre.*
No. 75	31.99
Creole	32.55
H 6	30·74
H 6 strain 1	30.57

The yield was somewhat lower than that of the previous year. The total quantity of paddy reaped from this field was 15,757 lbs.

The duplicate and quadruplicate comparative trials on 1/16 acre plots of certain varieties gave the following mean results :—

Selected Creole		32.08
do do	strain 2	37.15
No. 75	strain 1	30.73
do	do 2	33·28
do	do 4	34·96

MANURIAL EXPERIMENTS

The manurial experiments were continued in the North Field Twenty-six plots, one-eight of an acre each were cross-dressed with sulphate of ammonia at the rate of 100 lbs. per acre : twenty-six plots, their duplicates, did not receive any nitrogenous manuring. The results obtained showed that the mean return from the manured plots was 32.25 bags per acre, and the mean of the unmanured plots 31.09 bags. The results confirm the conclusion arrived at from previous experiments, i.e. that in the period during which the rice land is fallow an accumulation of nitrogen sufficient for the needs of the crop takes place, and no increase in yield can be attributed to the addition of nitrogenous manure.

RICE IRRIGATED WITH ARTESIAN WELL WATER.

The plots in the Durban Park were planted on June 20th. and reaped between the 1st to 7th of November, the crop taking rather less than five months to mature. The varieties cultivated were Demerara Creole and No. 75.

Every alternate plot received a double forking at an interval of three months. The remainder were forked once only. The yields obtained from doubly and singly forked plots were :—

Doubly forked	29.60 bags per acre.
Singly "	27.65 " " "

A MUD BINDING GRASS.

[An article of exceptional interest in regard to the use of vegetation in making up the foreshore which appeared under the above title in the " Field " of November 17th, 1917, is here reproduced. Ed.]

An excellent illustration of the action of plants with respect to the flow and depth of rivers or streams may be seen at Poole Harbour in Hampshire. Large areas of mudflats there are being gradually covered with a grass which in time will, by its powers of holding the mud, raise much of the flat above water level. There are many aquatic and waterside plants whose roots, stems and leaves arrest the removal of soil, &c. by water, and by the accumulation of the solid matter brought down by streams build up as it were a foundation on which other plants obtain a footing, so that in time what was once swamp may be changed into forest. The fixation of sand flats and dunes by sand-binding grasses is a familiar feature of our sea coast. Yet there are few people who recognise the important part that is played by the insignificant looking plants by which this work is performed.

Attention was first called to a plant of this nature growing in the mud flats near Southampton by Lord Montagu, who stated that the mud banks on his property had in recent years increased very rapidly as the result of the growth of a grass which has somehow become established there and spread itself about the shores of Southampton Water, with the result that the whole of the estuary was covered with it. The plant was known locally as rice grass and sea grass, and it was supposed to have been brought there by a ship which had a quantity of rice grass on board. The accuracy of this story of its origin is, however, disputed. The grass was identified at Kew as a species of *Spartina*, of which two others are natives of the country· and it is now known botanically as *S· townsendii* † The question of its origin and botanical relationship need not concern us here. The

†The native South American species of "rice grass"—*S. brasiliensis* is closely related to this species,

important fact is that it was first recorded as existing in Southampton Water, in 1870, and that it now covers many thousands of acres of the flats there, as well as "running along every dyke and filling every pool." In 1908 the area over which it had extended was something like fifty miles wide.

The story of this plant has been told by several, including Dr. Stapf, of Kew, to whose very full and interesting account, published in the Journal of the Bournemouth Natural Science Society in 1913, we are indebted for most of what follows :—

Although Townsend's grass was found growing at Hythe, near Southampton as early as 1870, it was not until ten years after that botanists recognised it as a new and distinct species. It continued to be looked upon as a botanical curiosity until 1907, when Lord Montagu of Beaulieu called the attention of the Royal Commission for Coast Erosion to the startling rapidity with which it took possession of the foreshore of Beaulieu river, and its possible value as a land reclaiming agent. It is a vigorous, stout, stiff grass, about a yard high, forming close tufts, more or less circular in outline, the tufts measuring anything between 3ft. and 15ft. across. The leaf blades are rigid, pointed, blue green in colour, and they are borne on erect stems which spring from an interlacing, stoloniferous rootstock, the spreading growth of which, assisted by a copious root system, serves to bind the mud, gravel &c., firmly together. The flower spikes are erect and stiff, and the flowering season is from July to September. The plants flower abundantly, but the production of seeds is very uncertain, the best crop following a hot summer. They fall off and sink to the bottom, where they germinate on the mud, the seedlings quickly becoming established. Mud appears to be essential to the quick growth of the grass. "As all the mud flats are formed in comparatively quiet waters, we find the grass confined to these and entirely outside the zone of heavy surf and strong tides. On the flats themselves the limit to which the grass can spread is determned by the depth at high tide. Although the grass can stand much submersion, 3ft. of water at ordinary high tide seems to be the maximum that it can bear."

Townsend's grass is supposed to be of hybrid origin, but it is just as likely to be a sport of variation from *S. stricta* for the very good resaon that it breeds true from seeds. *S. stricta* is a widely distributed plant in Europe, growing in muddy salt creeks and marshes in our southern counties.

Not only has the aspect of the flats been altered, the eye meeting great expanses of green comparable to meadows or corn-fields, where there was previously a monotonous sheet of grey at low and at half tide ; the most important change concerns their physical condition. " It is obvious that the copious system of roots and stolons must contribute to the stabilisation and solidification of the mud. In addition to this binding action the stems and leaves act as a very effective strainer on the water, which is charged with solid particles, brought down by the streams, catching and precipitating them. The result is an accelerated and increased deposition of mud over the area tenanted by the grass. The level of the mud-bank becomes raised, the mud itself firmer. . . . If the process continues the muddy foreshore will gradually be replaced by *terra firma*." Another effect is that of protecting the shore against the erosive action of the sea. As this grass will not grow in deep water it is not likely to become troublesome to navigation ; on the contrary, it is a help towards making steep banks at the sides, and thus increasing the depth of the channel.

The plant can be transplanted as easily as other grasses, small tufts of it set in mud where the other conditions are suitable soon becoming established and quickly spreading by means of their creeping stolons.

It will be seen that Townsend's grass as a mud fixer and bank former is what marram grass is as a binder of sand and a builder of dunes, which serve as a natural sea wall in so many parts of the world. Both grasses have a value as fodder and bedding for cattle, also for thatching. The seeds of Townsend's

grass are said to be greedily eaten by birds, in which respect it is like another mud loving grass, *Zizania aquatica* or Canadian rice, which some years ago was introduced into this country in the belief that it would be of value as a marsh plant and provide food for water fowl, but there is no record that it succeeded in the several places where it was tried. Being an annual probably all the seeds were eaten by birds and other animals, rendering reproduction impossible. Townsend's grass, being perennial, has not been interfered with in that way.

JOHN WILLIAMS, F.I.C., F.C.S.

Born 1868—Died July 11th, 1917.

By the death of Mr. John Williams, senior Government Assistant Analyst, which occurred on July 11th, 1917, and was briefly recorded in the following number of the Journal of the Board of Agriculture, the Department of Science and Agriculture sustained a serious loss. He was born in the colony in 1868, and educated at Queen's College; of a quiet and studious disposition he secured the respect of his masters, and on leaving, entered the Government Laboratory as private assistant to Professor Harrison. Later he was appointed Assistant Government Analyst. From the first he took the keenest interest in his work, learning to master its minutest detail; he often described analytical chemistry as most fascinating and absorbing work. Quite early in his career he became a Fellow of the Chemical Society, and by careful study of its literature kept himself "up to date" in the latest discoveries and suggestions. Only a short time before his death he received the great honour of being

elected a Fellow of the Institute of Chemistry, which honour Professor Harrison stated had never previously been given to a Colonial Officer.

His one and only relaxation—if relaxaton it can be called, going into it as he did—was amateur photography; he spared neither time, labour or expense to make himself the best photographer in Georgetown. The Government frequently made use of him in this capacity. Photographs in the Hand-book of British Guiana, in various numbers of Xmas-tide and other publications bear evidence of his skill. In helping the Baby Saving League for Cinema Shows ; in giving Magic Lantern displays at Eve Leary, and for charitable objects he was always ready to give his time and service ; he was in touch with the best firms in England and America, and shortly before his death devoted a great deal of time to the latest process of coloured photography.

As a Government Officer he was loyal, conscientious and hard working. He made few friends, scarcely extending his circle of friendship beyond the intimates of his boyhood. His acquaintances were many and were among every section of the community. He was a devoted husband, a loving father, the true friend of his children. To his only relations, his wife's parents, a true and kind son ; and in every walk of life a courteous kindly gentleman. Friends, acquaintances, and all who knew him may say :—

" We did not realize his worth when we
Did casually accost him ;
Or know how much we valued him,
Until we lost him."

J. F. W.

NOTES ON MALARIA.

[The following is approved for publication by the Surgeon General, Editor.]

In the LANCET of September 29, 1917, Christy of the Royal Army Medical Corps tells us that soldiers as well as medical men must know how to prevent malarial infection, and that with this aim in view the following facts have been collected for the instruction of officers and men: *They are equally useful to the agriculturists of British Guiana.*

1. Malaria is a parasitic, infectious, epidemic disease conveyed from one person to another by the agency of mosquitoes.

2. The microscopic parasite causing it lives and develops in the corpuscles of the blood of man, and in the body of the mosquito.

3. There is no evidence to show that it can exist in any other animal or possibility of its existing free in nature.

4. When blood containing the parasite is sucked up by the mosquito from a person recovering from an attack of " fever," the parasites develop and multiply in the body of the insect, and after three to five days may be injected by it through the skin into the blood of other men, causing after an interval of eight to ten days, all the train of symptoms known as malarial fever.

5. *The Malaria Parasite.*—Shortly after the mosquito bite and the arrival of the parasites in the blood-stream they enter and commence development within the corpuscles.

6. After an interval of a few days the parasites have so multiplied in the blood of the person bitten that an attack of fever

sets in, the length of the interval mainly depending upon the number of bites, the number of parasites injected, and the temperature prevailing.

7. The fever may therefore not commence until the person is many miles from where he was bitten.

8. After an untreated attack has run its course the fever subsides and the microscope no longer shows active parasites within the corpuscles, but there still remain in the body two forms of the parasites : (a) Latent or resting forms in the liver, spleen, etc. (b) Specialised crescentic forms in the general circulation.

9. (a) The latent or resting forms retire after the attack from the general circulation and remain inactive in the liver, spleen, etc., until perhaps the treatment is relaxed, or till such time as the resisting power of the individual is lessened by chill, sun exposure, exhaustion, or other causes, when they may return to the circulation and again become active within the corpuscles, producting a relapse and a return of the patient to the hospital.

10. The relapse has most of the features of the primary attack with all its train of symptoms and ill effects.

11. (b) The crescentic bodies are not formed until the attack has run its course.

12. They remain in the general circulation beneath the skin for weeks, causing no symptoms, but when sucked into the stomach of certain species of mosquitoes they at once become active, and after certain changes pass from the stomach contents into the stomach wall, multiply enormously, and eventually invade the salivary glands of the insect, from whence they are injected during the act of sucking into the blood of man as fever-causing parasites. The mosquito has the power at the moment of sucking of injecting through a special tube in its proboscis an irritating salivary secretion probably for the purpose of preventing premature coagulation of the blood,

13. Only the crescentic bodies are capable of infecting and developing in the mosquito, and not the active forms of the parasite as seen in the corpuscles during the attack.

14. If after some weeks the crescentic body has not found its way to the mosquito's stomach it may die, or it may retire from the general circulation to the liver or spleen, where it can remain without causing symptoms for a long time. But any severe constitutional disturbance, such as might be caused by the removal of the individual from a warm to a cold climate, may result not only in these bodies reappearing in the circulation, but in their having the power to multiply and produce a crop of active fever causing parasites, and what is known as recurrent attacks, even after the lapse of two or three years.

15. As in the case of the relapse, the recurrent attack has most of the features of the primary attack, and any one returning say to South Africa and suffering from a recurrent attack, even in a district hitherto free from malaria and years after his return may become a danger to his friends or even the nucleus of an epidemic, if the right kind of a mosquito happens to be an inhabitant of the neighbourhood and if mosquito-net precautions are not thorough.

16. *The Mosquito.*—Only the female mosquito has the power of sucking blood, the male subsisting upon the juice of plants, fruit, etc.

17. Not all species of mosquito can convey malaria. The majority of the common species are harmless (except those which transmit yellow fever, elephantiasis, etc).

18. The few species which are capable of conveying it belong to the class Anophelinae, all of which are fragile insects not easily seen, comparatively silent, and whose bite leaves little irritation.

19. It is therefore unwise to commit oneself to the remark, so frequently heard, that there are no mosquitoes in a particular place or camp, without the opinion of an expert.

20. All mosquitoes lay their eggs upon water, and the larval and pupal stages of their life are spent in the water. They wriggle to the surface periodically to breathe.

21. When the pupa is ready to change into the mature insect it rises to the surface, the pupa-case splits down the back, the mosquito emerges, and, after an interval for its newly-formed wings to harden, it flies away.

22. If a thin layer of kerosene oil be spread upon the surface of the water neither larvae nor pupae can get their breathing tubes to the surface and all die of suffocation, a never-failing and ever-ready method of preventing mosquitoes hatching out of receptacles which cannot easily be emptied of water.

23. Where there is no water there can be no mosquitoes.

24. No other insect can convey malaria.. Where there is malaria there must be anopheline mosquitoes.

25. It does not follow that because there are anopheline mosquitoes there must be malaria. The insects though present may not have been infected and therefore may be harmless.

26. One bite is sufficient to cause an attack and one infected mosquito may give malaria to several persons in one night.

27. Those species of anopheline mosquitoes which convey malaria are not usually found away from human habitations, or if found are not likely to be infected. Consequently men on picket duty, or in bivouac or temporary camp, although severely bitten by mosquitoes, often run less risk of malaria than those in camps or hospitals on lines of communication, where numbers of men who have suffered from malaria are congregated and where every anopheline mosquito is likely to be infected.

28. *The Mosquito Net.*—The segregation of the individual beneath an efficient net at night is by far the most important

and effective means, not only of guarding against a primary attack· but of preventing infection being carried from the sick person to healthy persons.

29. Owing to the development of crescentic carrier bodies after and during the continuance of the fever the use of an efficient mosquito net is far more important to the welfare of the community after than before the attack.

30. One person or even a baby with crescentic bodies in its blood sleeping without a mosquito net, or with one that is defective, may be and often is the nucleus of an epidemic.

31. Hence arises the danger of sleeping near a native village, because in a malarial locality a large percentage of the youngest children have active parasites and cresentic bodies in their blood· and yet they play about without showing symptoms of fever·

32. Adult natives, on the other hand, in a malarial locality are not usually a danger, for having suffered severely in early childhood they have acquired a partial immunity, and in consequence suffer little from malaria.

33. Strangers, however, from upland regions where there is no malaria, not having suffered from the disease in childhood· have acquired no immunity, and are soon likely to be infected on reaching a malarial district at a lower level.

34. Indians rarely seem to acquire any immunity and are very susceptible to malaria. Their proximity is a danger to Europeans.

35. A mosquito net to be effective should be large enough to prevent the arms and knees being bitten through it· and also to allow of its being tucked in all around.

36. An efficient mosquito net properly used is a protection in tropical Africa against attacks from many harmful insects and animals besides mosquitoes· For example : Flies which lay

their eggs in the skin or in the nose at night, the maggots hatched from which sometimes cause irreparable injury or even death ; scorpions ; several species of dangerous centipedes ; poisonous ants ; beetles of many sorts which injure by biting, ejecting poisons, or by entering the ears ; ticks whose bite conveys fever ; snakes, lizards, rats, etc., and, by means of its calico top, from dust and dirt dropped from above in hut or tent, or from heavy dew when sleeping in the open.

37. The lightest and smallest net which can be made serviceable under all circumstances, whether in hospital, clearing station, camp or bivouac, is one with calico top 5 feet 6 inches long by 2 feet broad and with sides 3 feet deep (2 feet of netting and 1 foot of calico tuck-in). At each four top corners are double tapes, 8 inches long, for fixing the net to its supports.

38. The latest approved ordnance pattern is a rectangular net of the above dimensions. To be effective it must be suspended by means of its corner tapes inside its supporting sticks, otherwise it cannot be tucked in. On no account should it be placed over its supports nor allowed to sag or hang loose.

39. For military purposes the mosquito net should of course be khaki, or any less conspicuous colour than white, but khaki netting being unobtainable it is advisable for each man for his own safety to dye his net with Condy's fluid or other colouring agent.

40. There are other methods of individual segregation than by the mosquito net. The best of these is by the use of "bamber oil," a mosquito lotion used extensively by coolies on the plantations in Ceylon, etc. Its composition is as follows :—

Citronella oil (not lemon-grass oil) 1½ parts
Kerosene (paraffin) oil 1 part ;
Coconut oil, 2 parts

To which is added carbolic acid 1 per cent. Its efficacy lasts from four to six hours, sufficient to give a night's sleep in comparative safety when a mosquito net is not avaiable or cannot be used.

41. *Quinine.*—Quinine is the only drug in the world which will kill the malaria parasite, and consequently quinine is the only drug of any use as a prophylactic against malaria—that is, for the prevention of primary attacks,—and it is the only medicine which will cure the disease.

42. Quinine being absorbed into the blood kills the parasite freshly injected by the mosquito, but when after three or four hours these have entered the corpuscles quinine has less effect upon them.

43. Quinine should therefore be taken early after any risk has been incurred, but as the exact time of the risk can rarely be determined the best way to accomplish this is to take it frequently.

44. A daily dose of 5 grains after the evening meal is for many reasons the wisest procedure.

45. A dose of 5 grains taken at 10 p.m. will kill any parasites which may have been injected by mosquitoes during the evening. and will remain in the blood long enough to put out of action any that may be introduced up to 6 a.m. next morning. The hours of daylight need not, of course, be provided for.

46. If quinine is taken only on Saturdays and Sundays a person may be bitten by infected mosquitoes on the Monday, and the parasites so injected may have so mutiplied in the body by the time Saturday comes round again that an attack of fever is unavoidable.

47. Quinine alone will not reduce the chances of infection more than perhaps 25 or 30 per cent. but quinine plus the intelligent use of an efficient mosquito net should reduce those chances by at least 90 per cent.

48. Quinine is the only specific for malaria. It cuts short the attack by killing the young parasites as each successive crop develops in the blood.

49. If taken in sufficient quantities during the attack it will prevent the formation of the crescent bodies, which once formed constitute the convalescing patient a danger to his fellows, and in spite of quinine may remain in the body for a long period.

50. A slight attack is just as dangerous in this respect as a severe one, and a person refusing to go sick " for a little fever " and neglecting to take quinine deserves to be severely dealt with.

51. If continued after the attack in sufficient doses daily it will account for all the resting, latent forms of the parasite in the spleen, etc., prevent relapses, and bring about a permanent cure, but the mosquito-net protection must be efficient and fresh attacks from bites of infected mosquitoes not allowed to supervene.

52. A good method of quinine after-treatment—that is, from the date of the subsidence of the fever is as follows :

At least	20	grains	daily	for	2	weeks
"	15	"	"	"	2	"
"	5	"	"	"	2	months

53. With the quinine may be combined, if necessary, iron and arsenic tonics as ordered by the medical officer.

54. Opinions regarding the after-treatment by quinine frequently differ as to when and how the drug should be taken, but the main point to realize is that the dosage should be daily for three months and the daily dose sufficiently large during the first month of the three. If a relapse should occur the three months' treatment must be commenced afresh.

55. Neglect of quinine after the attack will certainly result in a relapse, which may mean the development of additional resting forms and crescentic bodies, as well as the further decrease of the resisting power of the body, tending to other relapses and general debility.

56. The deafness and other slight effects of taking quinine are not permanent. However unpleasant the effects may be they are infinitely preferable to the risk of permanent inefficincy or loss of life.

57. Although the taking of quinine has in some cases resulted in the passing of black water unaccompanied by any fever, quinine is certainly not the cause of blackwater fever.

58. Although we may not know precisely what is the cause of this disease, there is plenty of evidence to show that malaria is the initial factor. To prevent malaria by the careful use of a net, or to bring about a permanent cure by energetic treatment by quinine. is the only way of avoiding a risk of blackwater fever.

THE KOKERIT PALM.

By L. S. Hohenkerk.
Forestry Officer
Depaitment of Lands and Mines, British Guiana.

For years past there has been a large and evergrowing demand for vegetable oils to be used in cookery and in the manufacture of butter and soap—a demand which the available supply rarely, if ever satisfies. It is evident that the discovery of new sources of raw material or the further development and increase in the production of old sources are the only means of overtaking this demand. Any information therefore, which would lead to the exploitation of a new source of vegetable oils should be welcomed, more especially if such be a natural forest product and not a cultivated one. For this reason attention is drawn to the possibilities as an oil producer of the kernel of the

Kokerit Palm (*Maximiliana Regia,* Martius,) and to the wide distribution of that palm throughout the easily accessible forest areas of British Guiana.

The Director of the Imperial Institute furnished a report dated 25th January 1916 on a small sample of Kokerit fruit and oil forwarded by the Director of Science and Agriculture of this Colony for examination by the Institute, and from that report the following information and extracts have been taken :—

Kokerit fruits are brown, rounded at base, pointed at apex, 1½ to 2 inches long and ¾ to 1 inch in diameter. Each fruit consits of (1) the pericarp, which is brown, tough and fibrous on the outside but internally soft, pulpy and containing oil ; the latter is the edible part of the fruit ; (2) the nut, brown in colour consisting of a hard woody shell enclosing 2 or 3 kernels ; and (3) the kernel, long, narrow and flattened in shape, covered with a greyish brown mottled skin, whilst internally they are whitish and resemble African palm kernels in consistency.

The pericarp yielded 17.1 per cent. from the dry pulp, or 2.6 per cent. from the whole fruit, of a semi-solid, orange-red oil resembling African palm oil in appearance but differing somewhat from it in chemical composition and yielding a much smaller quantity of oil. The conclusion was that kokerit pericarp oil would be readily marketable if it could be obtained in quantity

The kernels yielded 64.1 per cent from the dry kernels or 9.7 per cent. from the whole fruit, of a fairly hard cream-coloured fat with an odour resembling that of coconut oil which the chemical examination showed to be similar to African palm kernel and coconut oils. The yield of the kokerit kernels, it was stated, " compares favourably with that from best varieties " of oil palm fruits. Moreover since the kernels yield rather " more oil than palm kernels and the oil itself is quite comparable " with palm kernel and coconut oils ; there can be no doubt that " kokerit kernels would fetch the same price as palm kernels or " possibly a little more. The present price of palm kernels in " Liverpool is £26.10s. per ton (18th January 1916)."

The meal left after extraction of the oil from the kernels was pale brown with a mild and not unpleasant taste somewhat suggestive of coconut. The chemical examination of this meal indicated that it should have a feeding value apporximately equal to that of palm kernel cake and somewhat lower than that of coconut cake.

The report goes on to state : " The sole question, there " fore, is as to whether kokerit kernels can be produced in " British Guiana at a price which will admit of their being sold " in Liverpool at about the same price as palm kernels. In this " connection it is important to ascertain whether the fruits are " obtainable in British Guiana in large quantities in easily acces- " sible areas ; it would probably not be remunerative to " export the whole fruits so that it become so imporatant to " consider the extraction of the kernels.

In concluding the Director made a request for a consignment of about 6 cwt. of the fruits for technical trial by the Institute and arrangements will be made to ship this quantity at the earliest possible date.

The kokerit palm is found in all of the easily accessible areas of the Colony growing on more or less swampy land and also on the slightly elevated clay and sandy-clay soils. The mid-ribs of the leaves are made into brooms and the leaves are used for thatching houses and for this purpose the palm is cut down in large numbers. It is also cut, but in lesser numbers, in order to obtain its fruit, the fleshy portion of which is eaten. In view of the value of the kernels as an oil producer it would seem advisable to place some restrictions on indiscriminate felling of this palm and while thus preventing its destruction this would assist in materially increasing its numbers.

It is not certain at what age these palms begin to fruit ; they usually produce 2 or 3 bunches of fruit at one time, averaging about 100 lbs in weight. The principal fruiting season is between May and August, and a smaller crop may be obtained about December to February. Certain of these palms

are never seen with fruit, the spadices having only male flowers, while others have both male and female.

The kokerit palm is abundant in the Canje River and its tributaries and an estimate of its numbers therein was obtained by me during an inspection of the forests of that district in 1914-1915, while acting as Forestry Officer.

In Canje River 55 Sectional Surveys were made from Brotherson Creek up to the savannahs and 18 on the Ikuruwa River (which is a large tributary 57 miles up on the right bank of the Canje) extending up to midway on Ikuruwa Lake. The Sections were taken at intervals on these rivers and over a width of about half a mile on each bank along a total distance of about 80 miles. On the Canje between Calabash and Brotherson Creeks, a distance of say 7 miles, no sectional surveys were made, but inspection showed this area to be equally rich in these palms. The total area covered by inspection and surveys would therefore be about 90 square miles.

Only palms with stems were counted i.e., those in bearing and others which would fruit in a few years and these were found in 76.7 per cent. of the total of 73 sections counted. In all of the sections there were numbers of younger growing palms.

The average number of palms with stems was found to be 6.12 per section which would give 11,373 per square mile or a total of 1,023,570 over the 90 square miles.

From the foregoing paragraphs it is possible to form a rough estimate of the quantity of kokerit kernel oil which could be obtained from the Canje district alone, and I am tempted to make this estimate with the object of showing of what value to the Colony this industry could be made.

For the purpose of the estimate take one half of the number of stems estimated over the 90 square miles, or 511,785 as fruiting trees each of which would produce, say, only one bunch

per annum of an average weight of say only 50 lbs. From this the weight of fruit would equal 25,589,250 lbs. on the bunch and as the percentage of kernel oil to the whole fruit was found to be 9·7 per cent. this weight of fruit would produce 2,482, 175 lbs. or 1,108 tons of oil. Calculated at the low pre-war rate say £22 per ton the value of the kernel oil would be £24,376 or $117,000 per annum

The prices for palm kernel oil quoted in the "Public Ledger" of 1st December 1917 were :—Crude Extracted £51, Crude Crushed £52, and Refined Oil £67 per ton, or about 2½ times the value used in the above calculation.

Besides the kernel oil there would also be the residuent cake or kernel meal, amounting to about 60 tons for the above weight of fruit, the price for which, by the same paper, was quoted at the end of 1917 at £26 or $124.80 per ton

No estimate has been made of the quantity of pericarp oil which could be obtained (at the rate, already given, of 2.6 per cent. of the whole fruit) for the following reasons : (a) the fleshy part of the fruit falling from the trees would be eaten by animals or by the collecting parties, and (b) in order to obtain whole fruit for the purpose of extracting this oil it would be necessary for the collectors to either fell the trees or to beat or poke the fruit off the branches with long sticks.

In the fruiting season the nuts cleaned of the pericarp are to be found in large numbers at the foot of each tree. I have myself seen hundreds of tons of these nuts lying under the trees in Canje and Berbice rivers at the end of the fruiting season and it would seem to me to be more feasible to collect only the nuts and obtain from them kernel oil and cake than to obtain while fruit for the sake of the small extra amount of oil which could be extracted from the pericarp.

It will be noticed that the figures used in the above calculation have been halved in each case excepting only the percentage of oil to the fruit ; also that the Sectional Surveys

extended to only half a mile from each bank of the rivers and the yield has been calculated only from this area. Beyond those limits there are extensive forest areas in which the kokerit palm is nearly, or quite, as abundant as in the tract bordering the rivers, as shown by Sectional Surveys up the Kaboyari creek, but the question of transport would prevent collection of the nuts or fruit therefrom, at any rate in the near future. There are, however, large areas bordering the navigable branch creeks from which the nuts could be conveyed by boats.

In addition to the Canje district, which is a small one, the kokerit palm is to be found on all of the lands bordering the other rivers of the Colony from Courantyne to the North Western District. From personal observation the Berbice River for about 150 miles up is nearly, or perhaps, equally as rich in kokerit as the Canje but in other rivers it is less abundant. There are unfortunately, no figures on which to base any calculations as to the estimated number of trees on, or the probable yield from, the remaining easily accessible areas, but after making due allowance for the less prolific places, the other districts together should yield considerably more than 5 times the amount estimated for the Canje district.

The native method of extracting kernel oil is both crude and costly and only a few persons in both Canje and Berbice Rivers are known to be pursuing this minor industry. The nuts after being collected are sun-dried ; the shells broken by beating or pounding ; the broken shells and kernels are boiled and the oil skimmed off as it rises to the surface. The cost of a bottle of oil, say one-sixth of a gallon, in 1917 was 2s. as against a market quotation of about 4s. 1d. per gallon.

Unless machinery is introduced for the purpose of breaking the nuts and extracting the oil it would be hopeless to expect that the production would rise above a score or two gallons of oil per annum. By the report of the Imperial Institute, there was no machine (so far as they knew) suiable for the extraction of these kernels ; but, it was stated a machine was in use in Brazil for extracting babassu kernels, which present a similar problem.

and enquiries were being made there on the subject. It was considered possible that this machine would also be suitable for kokerit fruits and if this be so it was suggested it might be feasible to treat kokerit fruits in the machine to obtain a mixture of (a) kernels and (b) shells and pericarp. The suggestion was also made that the former could be separated and exported, whilst the mixed shells and pericarp could perhaps be worked by a modern extraction process for the production of pericarp oil. I have already noted the difficulty of collecting whole fruit and the feasibility of collecting the nuts only from under the trees and if capital were put into this industry the better plan would be to obtain machinery to crack the shells and extract the oil in the Colony, and then export both kernel oil and meal to the home markets.

As machinery for the purpose is unobtainable at the present time I see no reason why an export of kokerit kernels could not be started in a comparatively short time. These nuts could be collected by both men and women who reside on the banks of these rivers and are surrounded by the palms. The collection could be made either while returning to their homes from their fields or work places, or by making special journeys to the palm trees in their neighbourhood. The nuts could be sun-dried and broken and the kernels picked out and packed into baskets by women and children, and the baskets could be conveniently shipped by steamer, launch or boat for sale to any one of the firms in the Colony. I have seen mention made somewhere with reference to African palm kernels that by boiling the nuts before drying them the kernels are loosened from the shell and are more easily separated from the shell after it is broken and the experiment is worthy of a trial with kokerit nuts.

It would, perhaps, be a good idea to get the Aboriginal Indians interested in this industry. They dwell along the rivers and in Indian Reservations where these palms are, more or less, abundant and by giving all information possible on the subject and telling them what prices would be paid per pound for them, they could possibly be induced to make a start in producing kokerit kernels. As in the case of balata worked by the Indians,

sales could be effected through the officers of this Department. Perhaps some of the Ministers in charge of Missions in the various rivers would help in the matter by offering advice and instruction.

With regard to the price which firms in this Colony could offer for these kernels the following table gives the values of African palm kernels and would apply to kokerit kernels which, as already stated, are of equal value :—

VALUES IN LIVERPOOL.

YEAR	PER TON	PER 100 LBS.
1907	£12.8.2½	$ 2.66
1912	£15.3.0½	$ 3.25
1913	£17.15.11¾	$ 3.81
1916 (Jany)	£26.10	$ 5.68
1917 (Decr)	£*26.10	$ 5.68

The first three were obtained from a pamphlet "Nigeria and its products," the 4th from the Report of the Imperial Institute and the last from the "Public Ledger" of 1st December 1917.

The Mean value of the three years before the war is equal to $3.24 per 100 lbs and it will be seen that a steady rise in price had occurred up to 1913 and a big jump to 1916.

The price that could be offered by the firms in this Colony would be governed by overhead charges, handling, freight, insurance, and value in the home market. The market value being given above, it should therefore be possible to calculate on a pre-war basis, the price that could be paid in the Colony so as to leave a good margin for profit and to cover any losses that may occur. It would seem to me from the above figures, and the suggestion is therefore made, that a fair price would be one cent per lb. on the spot i.e., steamer or launch frieght to be paid by the firm purchasing the kernels.

*Maximum price fixed by Government Food Controller.

In order to initiate and foster this industry I would suggest that the natives be allowed to collect these nuts, which are now a waste material, free of cost, at any rate for the present. Or, if it be thought necessary to issue a permit to each collector for purposes of registration and control, that the fee charged for this be a nominal one of say 25 cents per annum.

I would further suggest that an export tax be charged of not more than £1 per ton of kernels shipped.

There are other palms growing in numbers in this Colony the fruit of which are known to yield, from both pericarp and kernel, edible oils of a high value, as for instance :—

Awarra—*Astrocaryum tucumoides*
Akuyuro (Aquero)—*Astrocaryum tucuma*
Abbeh (or West African Oil palm)—*Elaeis Spp.*
Turu (Tooroo)—*Oenocarpus bacaba* ?

In the case of some other indigenous palms we have no knowledge of the oil producing capabilities of their fruit, for example.

Ité (Aeta)—*Mauritia flexuosa.*
Manicole—*Euterpe Spp.*
Paripi—*Bactris Spp.*
Truli—*Manicaria saccifear.*

and it would seem advisable to forward shipments for examina tion by the Imperial Institute of at least the first two (Ité and Manicole) which are abundant in many districts.

It may be noted that two firms have already been granted permissions to collect palm fruits by the Government, viz :—(1) The Creeklands Rubber & Produce Coy Ltd, to collect nuts of palms including kokerit and the fruit of a few forest trees, on the Crown lands bounded by the Berbice and Courantyne Rivers and from the Coast to Wikki River, Berbice ; and (2)

Garnett & Coy Ltd, to collect the nuts of the Ité palm, only on the Crown lands in the Mahaicony River District.

In conclusion I sincerely hope that the few hours of thought and work which have been devoted to this subject will be the means of inducing both the river-dwellers and the merchants in the Colony to make some effort to collect and export these kernels. Their product is so urgently required at the present time that many places, including British Guiana, have prohibited the export, except under special permit, of all oil-producing nuts, in order to make good the expected shortage in the imports of butter, oils and fats.

THE BANANA: A FOOD OF EXCEPTIONAL VALUE.

By Professor Samuel C. Prescot.

Professor of Industrial Microbiology, Massachusetts Institute of Technology.

From The Scientific Monthly, Vol. VI. No. 1 January 1918.

The banana of commerce is the fruit of various species of *Musa*, a plant which develops abundantly throughout the whole tropical zone. Many species of *Musa* are known, differing in size and character, and their fruits likewise show differences in size appearance and flavour. Various common names are given to the different varieties, such as red bananas, yellow bananas, apple banana, date banana, lady finger, etc. The banana found principally in the American market is the fruit of *Musa sapientum*, of which there are a large number of varieties, the most common being the Gros Michel banana. The plants and their fruits differ considerably in appearance and actual composition, according to the environmental conditions of soil, climate and other geographical and geological features.

The banana constitutes the chief carbohydrate food, in fact the principal food of enormous numbers of people in many parts of the tropics, thus taking the place of cereals and tubers, such as wheat, rye, barley and potatoes, in the food relations of the temperate zone. Careful computations have been made by numerous authors showing that the actual amount of food material produced per acre in the cultivation of bananas exceeds that of wheat or any other crop. The banana is therefore to be considered not as a luxury but as a very important staple in the food supply of the world. From this point of view it deserves much higher consideration than it has hitherto been accorded.

Since the edible portion is surrounded by a thick enveloping skin it is effectively protected against the attacks of bacteria, moulds and other agencies of decomposition, therefore if the skin is unbroken it may always be eaten with the assurance of its sanitary quality and freedom from dirt or objectionable material

THE COMPOSITION OF THE BANANA.

Many analyses of the banana have been made by different investigators. Since we are especially interested in the American banana, it is probable that the average of the American analyses may best be quoted: Atwater and Bryant working under the auspices of the U.S. Department of Agriculture, give the following figures, showing the analysis of the edible portion of the banana, U.S. Department of Agriculture, Bull. No. 28, revised edition, 1906 p. 71 :

	Water. per cent.	Portein. per cent.	Fat
Minimum	66.3	1.0	.0
Maximum	81.6	1.6	1.4
Average	75.3	1.3	.6

	Total carbohydrate per cent.	Ash per cent.	Fuel value per lb.
Minimum	16.3	.5	330
Maximum	29.8	1.1	640
Average	22.0	.8	460

The banana as purchased contains, of course, a large amount of inedible material, the skin, which amounts approximately to 35 per cent. of the total weight. Since, however, bananas are ordinarily not purchased by weight, but by number, this does not enter into the general question of either cost or food value. The ash of the banana is principally made up of the phosphates, sulphates and chlorides of potash, soda, magnesia and lime, all of which serve useful purposes in the body economy. It is thus seen that the banana contains all the classes of food materials required for the animal body, although the amount of protein and fat are too low in proporiton to the carbohydrate to constitute a perfectly balanced ration. The combination of banana with milk in proper proportion, or its utilization as a vegetable to supplement a diet containing a small amount of meat will produce a ration which is ample to take care of the body needs.

COMPARISON OF BANANA AND POTATO AND OTHER FOODS.

A comparison of the banana with the potato is of particular interest. Again quoting from the carefully made tables of Atwater and Bryant, page 68 of Bull. No. 28, above mentioned, we have the following figures :

	Potato per cent.	Banana per cent.
Water	78.3	75.3
Portein	2.2	1.3
Fat	.1	.6
Total corbohydrate, including fibre	18.0	22.0
Ash	1.0	.8
Calories per lb.	385	460

It is thus seen that considering the edible portion, the banana approximates very closely the potato in analysis and exceeds it by about 20 per cent. in its fuel or food value.

Without giving the detailed figures of analyses, it may be of interest to compare the food value of the banana with that of a variety of other foods which we have come to regard as almost indispensable in a properly regulated dietary. The following table from Bulletin No. 28, mentioned above, shows the calorific value per pound of edible portion except as otherwise noted, of some of these foods, the average result being used in each case for comparison :

Banana	460
Spinach	110
Squash	215
Green peas	465
Onions	225
Parsnips	300
Cabbage	145
Green Corn	470
Fresh lima beans	570
Beets	215
Macaroni, cooked	415
Boiled oatmeal	285
Asparagus	105
String beans	95
Carrots	210
Clams, raw	240
Lobster	390
Oysters, solids as purchased	230
Scallops	345
Haddock	335
Flounder	290
Halibut, as purchased	470
Bluefish	410
Chicken, broilers, edible portion	505
Pickled tripe	270
Round steak, very lean	540
Round steak, medium fat	950
Milk, whole, as purchased	325
Apples	290
Cherries	365

Figs	380
Grapes	450
Oranges	240

A casual survey of this table shows that the banana exceeds in real food value many foods of different classes which are in almost daily use, such as whole milk, boiled oatmeal, shellfish and other fish, and fresh vegetables. Comparison of the food value of bananas and meats, as for example, round steak, should not be made without calling attention to the fact that the type of food is different in two classes. Meats are essentially protein foods and as such are more adapted to the development of tissue than to the quick production of heat, while the banana, on the other hand, is less a tissue-forming substances but is incomparably more effective in supplying the heat-giving materials. In a crude way we might say that the proteins are the foods which make good the losses due to wear and tear in the machinery of the body, while the carbohydrates are the foods which keep the machinery in motion and do the work. From this standpoint it is seen therefore that the banana, because of its higher carbohydrate content along with a certain amount of protein, would be a more useful all-round food than a pure meat diet in which the amount of carbohydrate is nil. A comparison with medium round steak, for example, shows in the edible portion in each case 65.5 per cent. water for the steak as against 75.3 for the banana, and protein content 20.3 for the meat and a fat of 13.6 per cent. as against the figures for the same constituents of the banana. On the other hand, the meat posesses no carbohydrate, whereas the banana has 22 per cent.

From the standpoint of the consumer the fairest method of comparison between these facts would be in noting the cost in cents per calories of fuel value obtained. At the present market price of meats the advantage is distinctly in favour of the banana. A similar comparison with fish is not without interest. Taking haddock as a food-fish now largely used, we purchase with each pound of fish approximately twelve ounces of water, that is to say, the haddock contains approximately 81 per cent. to 82 per cent. of water as against 75.3 per cent. in the banana. The

fish shows a larger proportion of protein, but the fat content however, is less than in the banana and there is no carbohydrate, whereas, as we have seen, the banana, is rich in this quick-acting, heat-giving substance. From the standpoint of calories, therefore the banana exceeds the common food fish considerably and from the standpoint of real costs the odds are greatly in favour of the fruit. If we compare the food value and cost of potatoes and bananas at the present retail price, $1.00 per peck and 25 cents to 30 cents per dozen, respectively, we shall find that of these two substances which are essentially similar in their analyses, there is a decided advantage in favour of the banana. At present prices, April, 1917, when purchasing bananas, one cent will buy 65.9 calories on the average, while in buying potatoes this sum secures 46.6 calories—a 40 per cent. difference in favour of the tropical fruit. In this connection it is perhaps well to call the attention to the fact that the banana can be cooked in a variety of ways and may replace the potato admirably. It may be baked, boiled, fried, served as chips, or "French fried," and in all these ways is an excellent and highly nutritious article of food. For use as a vegetable in the ways just mentioned it is found, of advantage to use fruit which has not reached the state of full-ripeness as the starch content is then greatest and the sugars less while for desserts and for eating in the natural state the rich sugary fruit is more acceptable.

Bulletin No 7 of the Bureau of Public Health Education of the New York Department of Health, issued February, 1917, says :—

The onion, like most green vegetables, is of value in the diet chiefly for the mineral salts which it contains. It is these and not its protein that make it a valuable addition to bread and meat. Bread and cereals and meat are described by the chemist as having an excess of acid-forming over base-forming minerals. A proper balance of these two classes of minerals in the diet is essential to health. There is danger at the present time, when vegetables are unusually costly, that the health of the community may suffer from a deficiency of base-forming materials in the diet. It is important therefore, to call attention to the fact that apples, bananas and oranges, which have not greatly advanced in price may be used as substitutes for vegetables. They contain the same mineral matters in varying proportions. Apples, bananas and oranges all surpass onions in their excess of base-forming minerals. On Saturday, February 24th, a member

of the Home Economics department of Hunter College investigated the prices of fruits and vegetables on the upper east side of Manhattan. A few of the prices, with some other facts, are given below:

	Avg. cost lb.	Per cent. refuse of	Avg. cost per lb. edible portion.	Food Units per lb. of edible portion.
Bananas	$.04	35	$.054	460
Cooking apples	.04	25	. 05	200
Small oranges	.05	27	.0635	240
Onions	.15	10	.105	220

It is therefore evident that these fruits are all cheaper than onions.

It is also clear that on the basis of food value, the banana is nearly a third cheaper.

Analysis made in the laboratory of the writer gave the following results :

ANALYSIS OF BANANA ASH.

Silica	2·19
Lime	1.82
Iron oxide	0.18
Phosphoric acid	7·68
Magnesia	6.45
Soda	15.11
Potash	43.55
Sulphur trioxide	3.26
Chlorine	7.23

That is, the ash is largely made up of the base-forming salts, the carbonates, phosphates, chlorides and sulphates of potash, soda and magnesia.

Below will be found a table which has been prepared from analyses shown in Bulletin No. 28 previously referred to, and from the data accumulated by Professor H. C. Sherman of

Columbia University, and other authentic sources, where is shown the analysis of a number of foods both of animal and vegetable origin and their comparative calorific value based on present prices. The costs per pound have been obtained as a result of a number of actual purchases made at retail in New York City and are therefore reliable.

THE NUTRITIVE RATIO

The nutritive ratio shown in the table may require a slight amount of explanation. This is based on the fundamental fact that proteins, carbohydrates and fats supply the actual food material to the body. Of these protein alone is nitrogenous material while fats and carbohydrate contain no nitrogen. Nutritive ratio really expresses the relation between the energy derived from the nitrogenous food and that derived from non-nitrogenous nutrients and is determined by a computation of the calorific value of the proteins as compared with fats and carbohydrates. Since the fats have a heat-giving value which is approximately 2¼ times that of either carbohydrates or protein, the energy relation of nitrogenous to non-nitrogenous material is not an exact expression of the percentages of protein and non-protein, but of the fuel or power-producing value. The figures in the table therefore represent the real amount of energy deprived from the total carbohydrate and fat calories as compared with the energy derived from the protein.

In this connection it should be explained, as suggested earlier, that the nitrogenous and non-nitrogenous foods serve somewhat different purposes in the body economy since the nitrogenous foods are mainly for the repair of tissue, while the non-nitrogenous ones are for the development of power (energy). For this reason it is undesirable and uneconomical to have too much protein. Only the nitrogen actually needed for repair and building of tissue is utilized the remainder being excreted. There is no storage against a future shortage as in the case of fat. Therefore in a properly balanced diet the amount of protein food should not ordinarily exceed 15 per cent. of the total fuel used. Moreover, the actual amount of fuel used varies with age and

occupation. Those doing hard manual labour need more energy and consequently more food. Growing children burn their food rapidly and need more protein in proportion to the total than do adults.

The general relation of foods to the body needs as well as their relative cost based on calorific value is well expressed in the following quotation from the bulletin on " Food : Fuel for the Human Engine," prepared by the recognised expert, Dr. Eugene Lyman Fisk and issued by the Life Extension Institute of New York during the present year (pp. 5-6).

There are three main groups of fuel foods. Here they are in order of cost per calorie, i.e., those giving the most energy for the money heading the list.

STARCHY FOODS.	SUGARS.	FATS.
Bananas	Sugar	Drippings
Cornmeal	Corn Syrup	Lard
Hominy	Dates	Salt pork
Broken rice	Candy	Oleomargarine
Oatmeal	Molasses	Nutmargarine
Flour	Most Fruits	Peanut Butter
Rice		Milk
Macaroni		Bacon
Spaghetti		Butter
Cornstarch		Cream
Dried lima beans		
Split peas, yellow		
Dried navy beans		
Bread		
Potatoes		

About 85 per cent. of the fuel should come from this group using starchy foods in largest amounts, fats next and sugars least. Fats, starchy foods and sugars are almost pure fuel, like coal, while cereal foods also contain some building and regulating material.

The same bulletin, presenting a table of the raw materials in common use in the order of their cost per pound, places bananas at the bottom of the list, i.e., the cheapest food.

THE HIGH-POWER FUEL.

The banana is not only a higher-power fuel for the body, but it is also rich in the desirable salts. The onion has long been considered a valuable food adjunct because of its mineral salts. The banana is even more valuable.

A little known commodity in America is banana flour, but in view of the shortage of materials it is one which should be seriously considered. The fully grown, but unripe banana, is the source as it is desired to obtain the carbohydrate in the form of starch before it goes over to soluble sugar. The peeled fruit is dried and ground, the water content is removed to approximately 15 per cent. and during this process the other ingredients are concentrated.

According to the eminent English dietic expert, Dr. Robert Hutchinson in " Food and the Principles of Dietetics," we find :

The unripe banana is dried and used to produce banana flour or meal. A sample of such flour had the following percentage composition

	Moisture	Proteid	Fat	Carbohy-drates	Mineral matter
Banana flour	13.0	4.0	0.5	80.0	2.5
Wheat flour	13.8	7.9	1.4	76.4	0.5

I have placed alongside of it the composition of good wheat flour, compared with which the banana meal is rich in carbohydrates and mineral matter, but very poor in proteid. If rice, on the other hand, had been taken for comparison, it would have been found that banana flour was without equal to it in nutritious value.

The *Lancet*, February, 1900, in a discussion of the banana as food says :

For some reason not yet explained, the starch of the banana is much more digestible than are the cereal starches besides which the fruit contains a notable proportion of nitrogenuous material.

In a later article (*The Lancet*, October 17, 1903,) this journal states:

> There can be no doubt of the nutritious character of banana flour, and the starch in it is peculiarly easy of solution and digestion in the alkaline digestive juices of the body. Banana flour is readily dissolved, for example, by the saliva.

Dr. Hutchinson also calls attention in "Food and Dietetics" to the fact that dried bananas compare favourably with dried figs in nutritive value.

During the recent rise in the cost of foodstuffs, Dr. Graham Lusk, at the request of the New York State Board of Health, complied a low-cost meatless dietary of high efficiency value. In speaking of this he said :

> Potatoes with their valuable alkaline salts had to be excluded from the diet because of their prohibitive price.

It is noted, however, that sliced bananas and sugar appear as a component of luncheon or supper. Many articles have appeared during the past ten years pointing out the high food value and the wholesomeness of this fruit.

The complaint is sometimes made that uncooked bananas are indigestible. Making a careful study of the subject, it is found that this statement is only partly true and should be modified to read that "uncooked, unripe bananas may be indigestible," for all evidence shows that the thoroughly ripened banana is not only digestible, but it is one of the easiest foods to digest in the whole dietary. Dr. Arnold Lorand of Carlsbad states that "as far as their digestibility is concerned I have personally noted that when eating a perfectly ripe banana it almost melts in the mouth when simply turned over several times without any actual mastication and only a few stringy fibres in the middle of the fruit will remain. In this way two or three large bananas may be eaten without there being any feeling of discomfort in the stomach. Of course bananas are only thus digestible when quite ripe ; those still somewhat green are less so, especially when they feel hard on the outside, although when

very well masticated they are easily dissolved." As as matter of fact, many people assume that when a banana begins to show brown or black spots on the skin it is past the period of ripeness, whereas it is approaching the point when it may be regarded as perfectly ripe.

Comparative studies on the length of time required for foods entering the stomach to be digested and passed on to the intestinal tract, have been published by numerous investigators. One which has stood the test of time shows the following figures :

Foods	Average time of indigestion. hr. min.
Ripe bananas	1.45
Oatmeal	3.5
Beans	2.30
Cabbage	4.30
Onions	2.5
Green peas	2.35
Boiled potatoes	3.30
Tomatoes	2.5
Turnips	4·0
Vegetable marrow	1.45
Boiled Beef	4·15
Roast beef	3.20
Roast mutton	3·15
Roast pork	5.20
Soft boiled eggs	3.30
Boiled fowl	3.0
Codfish	3.30
Mackerel	4.0
Apples	2.30
Nuts	4.0
Oranges	2.45
Plums	3.40

This table shows that of all these common foods the banana is the most readily digested. This is explainable by the fact

which was previously mentioned, that in the mouth during the process of mastication the carbohydrate is largely transformed into assimilable sugar and the further process of transformation in the stomach requires but a relatively short time. A meal of steak and potatoes would be seen according to the table given, to occupy approximately three and one half hours for the digestive changes of the mouth and stomach to take place, whereas the ripe banana fruit would be digested and ready for absorbtion in half that time. It has already been shown that the banana is actually richer in nutrients per pound of material than the common food-fish or the common food vegetables. The table just cited above shows that it also is a more easily digested food than fish or vegetables, requiring, a shorter time period for the digestive fluids to act in order to bring it into usable form.

GENERAL CONCLUSIONS.

The statements which have preceded should not fail to make it clear that in a period like the present when we are facing a general shortage of cereal and other carbohydrate food we may turn to the banana as one possible solution of our difficulty. The fact that bananas may be obtained in abundance throughout the year, that they may be shipped for long distances under suitable conditions without being impaired in any way, that they may be used either as a fruit or as a vegetable cooked or raw, in their normal form or dried or powdered, shows clearly that in this remarkable fruit we have an adjunct to our dietary which should not be underestimated. Used in connection with dried beans or peas or with dairy products such as milk and cheese or with lean meat, it serves perfectly to secure a properly balanced ration.

It is practically the only food which during the last two years has not shown a marked increase in price and to-day will stand comparison with any food upon the market on the basis of caloric costs. Everything points to its continued favour not merely as the " poor man's fruit " as it has sometimes been called, but as a staple food for universal use, and it is to be hoped that it will be employed in continually increasing amounts whether as a substitute for other foods which have become prohibitive in priec or because of its own inherent quality.

FOOD.	Refuse, per cent.	Water, per cent.	Total Indigestible Nutrients, per cent.	Digestible Nutrients. Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Ash, per cent.	Food Value. Per Pound Calories as purchased.	Edible Portion	Nutritive Ratio 1.	Average Time of Gastric Digestion. Hr. Min.	Cost per lb. as purchased in cents.	Cost per 100 Calories as purchased in cents.	Calories purchasable for 5 cents.
Bananas ...	35.0	48.9	1.6	.8	.4	14.3	.6	300	460	19.7	1.45	5	1.66	300
Beans, string ...	7.0	83.0	...	2.1	.3	6.9	.7	180	195	...	3.45	16	8.88	56
Beans, fresh Lima ...	55.0	30.8	...	3.2	.3	9.9	.8	255	570	...	...	9	3.53	141
Beans, dried ..	...	12.6	7.9	17.5	1.6	57.8	2.6	1,520	1,520	3.5	2.30	20	1.31	380
Potatoes, Irish ...	20.0	62.6	1.2	1.5	.1	14.0	.6	295	370	9.5	2.30	8	2.71	185
Potatoes, sweet ...	20.0	55.2	1.6	1.2	.5	20.8	.7	460	570	18.3	...	10	2.18	230
Squash ...	50.0	44.2	.4	.6	.2	4.3	.3	105	215	7.8	...	6	5.71	88
Oranges ...	27.0	63.4	1.0	.5	.1	7.7	.8	170	240	15.8	...	5	2.64	240
Milk, whole ...	...	87.0	.5	3.2	3.8	5.0	.5	310	310	4.3	3.15	5.5	1.77	282
Eggs, uncooked ...	11.2	65.5	1.1	12.7	8.8	...	.7	635	720	1.7	...	28	3.90	138
Beef, Ribs ...	20.3	43.8	1.8	13.5	20.0	...	.5	1,135	1,433	3.3	...	20	1.76	284
Beef, Roasted ...	...	44.1	...	22.3	28.6	...	1.3	2,805	...	...	4.15	...	...	...
Beef, boiled and salted...	...	38.1	...	26.2	34.9	...	.9	1,620	...	...	3.20	...	...	...
Mutton, hind quarter...	17.2	45.4	...	13.8	23.2	...	.7	1,235	1,495	..	3.00	25	2.02	247
Ham, smoked ...	14.0	34.8	...	14.2	33.4	...	4.2	1,675	1,940	...	...	30	1.79	279
Bread, white ...	...	35.3	2.9	7.8	1.2	52.0	.8	1,200	1,200	7.00	3.30	16	1.38	376

MEETING OF THE BOARD OF AGRICULTURE.

A meeting of the Board of Agriculture was held at the offices of the Board on Tuesday May 14th. His Excellency the Governor presiding.

THE VEGETABLE PRODUCTS FACTORY.

Professor Harrison stated that orders had been placed in the United States for machinery for the conversion of corn and rice into flour and the first shipment of such machinery was expected shortly. Referring to the subject of converting ground provisions into flour he stated that this was in a totally different position. The necessary machinery, it was estmiated, would cost $16,900 in New York. The total expenditure would be $25,000. It was questionable whether such an expenditure was justifiable at the present time.

THE CONGO WEED.

The attention of the meeting was drawn to a specimen of the so-called 'Congo Weed' (*Antidesma venosum*) which consisted of an underground root or ' runner ' 50 feet in length ; a sample of the foliage was also exhibited. The plant had been introduced from abroad by a previous Government Botanist and threatened to take over the park lands in the Botanic Gardens, it was also prevalent in other parts of the Gardens. It was an exceedingly difficult matter to eliminate it when once firmly established. At present it was confined to the Botanic Gardens, Georgetown, and some of the surrounding pastures. Mr. Waby suggested that the berries which it produced might be utilized, when properly prepared, as a substitute for red currant jelly.

EDITORSHIP OF THE JOURNAL OF THE BOARD OF AGRICULTURE.

Professor Harrison, in opening the discussion, gave a short survey of the events which had terminated in the resignation of the previous Editor Mr. Leechman. He also stated that as a temporary measure His Excellency had asked Mr. Bancroft to prepare a number of the Journal which he had done. It was now proposed to definitely appoint Mr. Bancroft as Editor and Mr. Bodkin as Assistant Editor. He felt that through these appointments the Journal would benefit by the experience and knowledge of two men who were in close touch with all scientific and practical agricultural matters. The members of the Board unanimously assented to these arrangements.

Professor Harrison intimated that in the near future the Journal would contain notes of meetings of the District Farmers Associations. He also suggested that a page might be reserved for notices of situations required or vacant which would serve as a means of bringing young men in search of employment in touch with the employers who required them. This was also agreed to.

COLONIAL AGRICULTURAL SHOW.

With regard to the proposal to hold a Colonial Agricultural Show and a West Indian Agricultural Conference in British Guiana during the year Professor Harrison stated that the Secretary of State did not approve of holding a show unless the people unanimously desired one. At the present juncture there were reasons that such money should be utilized to the advantage of the Empire.

With regard to the Conference the Secretary of State was of the same opinion but if it was universally desired to hold the next Conference in the colony the authorities in the neighbouring colonies might be communicated with in regard to making preliminary arrangements for holding a conference as soon as possible after the termination of the war.

This was agreed to and His Excellency stated that he would ıform the Secretary of State that such was the unanimous desire f the inhabitants of the Colony.

APPOINTMENTS OF RESIDENT AGRICULTURAL INSTRUCTORS.

Professor Harrison announced the appointments of such fficers to the West Bank, Demerara, Canals Polder, East Bank)emerara, and two appointments in Essequebo. It was agreed › make these appointments and also that they should be temorary, to terminate at the end of the next year, renewal if ecessary.

AGRICULTURAL SHOWS.

It was decided to hold no Agricultural Shows this year but ıat the money voted for the purpose should be allocated to ırmers competitions principally in connection with the raising of ɔodstuffs ; also a further sum of $300 be voted to such ɔmpetitions.

THE LOCUST CAMPAIGN

The Director of Science and Agriculture then announced ıat the total cost of the campaign had been $2,038·60 made up ; follows.

nportation of poisons and travelling expenses	$ 4,026.43
ess stock of poisons on hand reckoned at cost of importation	1,701.67
	2,324.76
tock of poisons issued to retailers at retail prices	235.80
	2,088.96
lus retailers commission (4 cts. per lb.)	50.36
Total cost..	$ 2,038.60

The area affected and dealt with was 250 square miles.

IMPORTATION OF A STALLION.

Enquiries as to importing a stallion from England at the present time had elicited the information that the freight alone would cost £100. Consequently the suggestion was made that the animal be imported from the U.S.A. A suggestion by Colonel Clark that the purchase of a good animal in the States be entrusted to a personal friend of his was agreed to. The former resolution to purchase a horse in England was therefore rescinded.

IMPORTATION OF PIGS.

Professor Harrison stated that owing to war conditions the cost of importing this live stock had very materially increased, but, despite this fact, he strongly recommended that such importations be continued as there was an ever increasing demand for pigs within the colony. The suggested prices of the progeny of pure and mixed strains of pigs imported by the Board of Agriculture were then put forward by Professor Harrison. These prices and the continued importation of pigs by the Board were agreed to.

The Board then adjourned *sine die*.

BOTANICAL NOTES.

NITROGEN CONTENT OF LEGUMES.

Experiments extending over a period of nearly twenty years have clearly demonstrated the value of nitrogenous manuring in increasing the yield of sugar from the sugar cane. The possibility of a shortage in the colony of sulphate of ammonia and of nitrate of soda for the next crop owing to the war, is to us, a matter of much concern. In order to keep the sugar crop up to the standard of past years other sources of nitrogen must be

sought. A possible substitute for artificial manuring with nitrogen is the growth of a leguminous crop in rotation with the sugar cane.

The following table of approximate nitrogen content of certain legumes, taken from the Hawaiian Agricultural Experiment Station Press Bulletn No. 52, is therefore of interest.

APPROXIMATE NITROGEN CONTENT OF LEGUME VARIETIES.

(Calculated on the basis of a ton of fresh cut stems and leaves.)

Variety	Nitrogen in total plant lbs.	Nitrogen in stems and leaves lbs.	Nitrogen in roots lbs.
Sunn hemp (*Crotolaria juncea*)	20.2	16.0	4.2
Indigo plant (*Indigofera anil*)	28.4	20.4	8 0
Rattlepod (*Crotolaria saltiana*)	23.5	15.3	8.2
Rattlepod (*Crotolaria incana*)	18.9	15.9	3.0
Oregon vetch	20.0	12.3	7.7
Jack bean (*Canavali ensiformis*)	16.3	15.0	1.3
Velvet beans	14.0	11.7	2.3
Otootan soy bean	20.0	15.7	4·3
Patridge pea (*Cassia chamaecrista*)	23.7	19.6	4.1
Cow peas	12.1	10.6	1.5
Hairy vetch	13.3	9.4	3.9
Florida beggar weed (*Desmodium tortuosum*)	19.0	15.6	3.4
Bachet soy bean	21.2	15.6	5.6
Spanish clover (*Desmodium unciatum*)	19.8	12.8	7.0
Sesbania aegyptiaca	11·4	7.1	4.3
German lupine	8.7	7.1	1.6
Phaseolus semietectus	17·3	13.6	3.7
Mung bean (*Phaseolus mungo*)	15.5	13.8	1.7
Kulthi (*Dolichos biflorus*)	12.5	11.6	0.9
Sensitive plant (*Mimosa pudica*)	13.7	6.8	6.9

PLANT DISEASES AND PESTS NOTES.

A WARNING.

THE "CONGO" WEED.

This plant, introduced by a former Government Botanist in 1907, has spread rapidly and threatens to become a scourge not only in public gardens and parks but also among cultivations in the colony. It spreads rapidly by "runners" which may attain a length of a hundred feet or more. Shoots are readily developed from these "runners," more particularly when they are wounded, as frequently takes place on the edges of drains where "cutlassing" has been done. In addition to "runners" the plant is propagated by seeds produced in clusters of small berries of a dark purple colour, which are readily eaten by birds, the seeds being deposited around the bases of trees. We strongly recommend all persons who possess cultivations or private gardens to destroy this pest. The most effective means of so doing is to dig the plant up wherever it appears and to burn it.

C. K. B.

FLY PAPERS.

In view of the present high price of imported fly papers the following method of making them locally, devised by Mr. L. D. Cleare jnr., is given.

Manilla wrapping paper 9 inches wide and weighing about 15 lbs. per roll of 150 yards is used. The paper is marked off into lengths of 12 inches, the end of one sheet being the commencement of the next, and a rectangular space of 10 x 8 inches is marked out on each sheet. A cardboard mask will be found convenient for this purpose. The paper is then cut up into lengths of ten (or other convenient number) sheets.

These strips are now made oil-proof by the application of a solution consisting of 1 oz. ordinary glue in 3 ozs. water. The

glue is dissolved in the water by heating and finally, if necessary, water is added to make up the full 3ozs. The solution is applied with a *fine* brush and *must completely and evenly cover the entire surface*· The strips are then allowed to dry.

After the paper has dried it is cut up into single sheets and the adhesive mixture consisting of 3½ ozs. resin and 1½ ozs. engine oil is brought to the boiling point and immediately applied to the paper. This mixture must be kept within the 10 x 8 rectngle, thus allowing an uncovered margin of 1 inch all round. Two sheets are now placed face to face and stored thus until required for use. *The papers must be stored flat* and for preference in a cool dry place. They should not be stored for longer than two weeks.

The cost of papers made in this way is comparatively small and the following figures were obtained in my experiments :—

Manilla paper	$ 1.68 per roll.
Glue	.16 per lb.
Resin	.05 per lb.
Engine Oil	.12 per pint.

A roll of paper (obtainable at Smith Bros., Water Street) will give 450 sheets which works out at 3 sheets for 1.1 cents or 20 sheets for 7.1 cents. One ounce of glue with three ounces of water will cover 20 sheets at the cost of 1 cent. Three and one half ounces of resin cost 1.1 cents and one and a half ounces of engine oil cost 1 cent ; these two together will cover 20 sheets at the cost of 2.1 cents. The total cost will therefore be about 10.2 cents for 20 single sheets, or 30.5 cents per lot of 30 double sheets.

AN EFFICIENT NUT-CRACKING MACHINE.

The following description of an effiicient nut-cracking machine is of special interest in connection with Mr. Hohenkerk's article on the Kokerite Palm.

"The *West India Committee Circular* for March 21st, 1918, draws attention to a recent American invention for cracking the hard shells of palm nuts produced in Mexico and Central America, solely by centrifugal force. The machine is shaped somewhat like a drum, and measures 6 feet in diameter. Its height, when top feed and bottom discharge appliances are added, is nearly 7 feet; it weighs approximately 6,000 lbs.

The nuts are conveyed in a steady stream to the hopper at the top, and from the hopper they drop into a fast revolving drum wheel which throws them with great force against a continuous stationary belt of breaker blocks lining the inside surface of the main drum-shaped casting.

A pressure of about 1,800 lb. is required to crack them, as the nuts have an extremely hard shell, about ½ inch thick. The drum wheel turning on a perpendicular set axle is speeded at 800 revolutions per minute, and hurls the nuts on a tangent a distance of about 2 feet. This force is sufficient to break the shells into several pieces and to release the kernels. Deflected by the downward sloping surface of the breaker block, the kernels and hulls drop toward the bottom of the machine, where they enter a discharge pipe, and are separated from each other by a system of blowers. The machine has a capacity of dealing with about 10 tons of nuts per hour.

The difficulty experienced heretofore in preparing these nuts for the market has been in the matter of cracking the hard inner shell. In Mexico this work is ordinarily done by hand, and is tedious and slow work. This machine solves the problem very advantageously, not only because of the greater speed, but because in cracking the nuts by centrifugal force the kernels for the most part remain whole, and do not loose any of their oil."

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first quarter of the year 1918. The corresponding figures for the two years previous, and the average for the four years previous to that, are added for convenience and comparison·

Product.	*Average 1912-13.*	*1916.*	*1617.*	*1918.*
Sugar, tons ...	17,295	23,856	27,791	17,757
Rum, gallons ...	1,022,208	1,938,593	1,458,439	359,129
Molasses, gallons...	47,093	...	200	7,400
Cattle-food, tons ...	1,382	520	755	575
Cacao, cwts. ...	99	29	...	50
Citrate of Lime, cwts.	1,958	45	14	...
Coconuts, thousands	511	650	593	305
Coconut Oil, gals....	...	...	...	...
Copra, cwts. ...	529	824	205	827
Coffee, cwts. ...	583	658	1,493	823
Kola-nuts, cwts. ...	...	...	...	...
Rice, tons ...	2,093	5,234	5,859	4,185
Ricemeal, tons ...	243	68	42	5
Cattle, head ...	228	173	282	154
Hides, No. ...	1,288	1,399	997	115
Pigs, No. ...	292	320	318	...
Sheep, head ...	3	21	3	3
Balata, cwts. ...	1,903	2,935	3,067	1,165
Charcoal, bags ...	17,245	16,264	11,562	8,295
Firewood, Wallaba, etc., tons ...	2,534	3,814	3,474	1,770
Gums, lbs. ...	444	883	112	...
Lumber, cub. ft. ...	60,194	161,445	36,930	27,082
Railway sleepers, No.	514	675	9,779	4,000
Rubber, cwts ...	2	45	40	52
Shingles, thousands	424	437	550	614
Timber, cub. ft. ...	74,485	67,569	6,719	2,060

GUAVA JELLY IN WAR TIME.

The guava takes first rank among tropical fruits· The most suitable preserving pan is an enamelled one. For stewing, the fruit should be carefully peeled, cut into halves or quarters with a sharp knife, the seeds extracted with an enamelled or silver spoon. The seeds and peels may be soaked or boiled in water, and the strained water used for cooking the fruit. To every 2 lbs. of peeled and cleansed fruit allow one pint of water, boil slowly till tender, taking care in stirring not to crush the friut. When soft, add 1½ lbs. of best granulated sugar, and boil quickly for 15 to 20 minutes. If this be put into wide-mouthed screw-topped bottles and covered immediately it will keep good for a long time.

In war-time yellow sugar may be substituted for the best granulated. If this is used it requires a little longer stewing and would need to be skimmed·

ELEANOR WABY.

ATTENDANCES AT THE DISTRICT GARDENS.

The following are the annual attendance of the District Gardens for the years 1912-1917 and the figures for the first quarter 1918.

YEAR.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Dem Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3;297	1,186	2,564	1,663	17,887
1918 1st Quarter	1,085	812	397	1,013	409	684	518	4,918